BIOARCHAEOLOGICAL INVESTIGATIONS OF HEALTH AND DEMOGRAPHY IN MEDIEVAL ASTURIAS, SPAIN

By

Nicholas V. Passalacqua

A DISSERTATION
Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Anthropology

2012

ABSTRACT

BIOARCHAEOLOGICAL INVESTIGATIONS OF HEALTH AND DEMOGRAPHY IN MEDIEVAL ASTURIAS, SPAIN

By

Nicholas V. Passalacqua

The purpose of this study is to investigate the impact of political and economic change on the health of people living in predominantly rural communities of Medieval Asturias, Spain from ~900-1800 AD. This project examines the remains of ~325 individuals recovered from 12 Medieval Christian church cemeteries located within the historically and politically defined boundaries of Asturias, Spain.

Iberia has a rich written history beginning with the first Romans to enter the peninsula and describe the peoples they encountered (Collins 2000). This history became more detailed as time progressed with multiple histories of events being recorded in the Medieval Period by different parties (Linehan 1993). Unfortunately, as is common in Medieval histories, these documents concern only the key individuals involved in large political events. The average individual has no written history, nor is there an anecdotal summary of what peasant life was like in Medieval Asturias. Due to this dearth of information, this dissertation takes a historical bioarchaeology approach using what information is available from the historical narrative relating to Medieval Asturias, in order to approach issues of the economy, inferred gender, and familial status roles and their relationship to pathological markers found in the human skeletal remains of this population.

Due to the often rushed nature of salvage archaeological methods, much contextual evidence was lost during excavation of many of these sites. Further the acidic mountainous soils

of Asturias often result in poorly preserved skeletal material. Here these pitfalls will be addressed using two unique approaches: (1) this project will examine life histories of the general rural population of Medieval Asturias at the *regional* level. This will be achieved by aggregating all individuals from the available archaeological sites, and directing hypotheses at regularities at the regional scale. (2) In order to tackle the issue of poor or differential preservation of human remains, this project will employ new maximum likelihood statistical procedures specifically designed to handle missing data and generate probability statements. It should be noted that while the robust statistical approaches taken here will focus on region-level analyses, they could also be applied to large well documented sites in future investigations.

Results demonstrate that while historians (e.g. Kamen 1991; Lynch 1992; Ortiz 1971; Ruiz 2007) suggest rampant collapse and crisis throughout much of the later Medieval and Spanish Empire periods, the biology of the individuals from the same time shows no record of significant increases in stress or disease. Many other scholars (e.g. Bennett 2005; Miller 2003; Lopez et al. 2012) suggest the patriarchal nature of Medieval and Imperial Spain resulted in negative health outcomes for females in comparison to their male counterparts, but this is again not detected in the present examination of the skeletal biology. Finally, historians (e.g. Bango Toviso 1992) and mortuary anthropologists (e.g. Naji 2005; Ivison 1993; Effros 1997) alike argue that the practice of *ad sanctos* burial favored those high status individuals who were most regarded in the community, for prestigious burial locations within churches, but these results found no significant differences in terms of mortality (risk of dying at younger ages) or the development of physiological stress markers.

This dissertation is dedicated to my Father Joseph Passalacqua
and Mother Susan Vere Passalacqua, to which I owe everything.

Acknowledgements

I first wish to thank my family. Without their unwavering support none of this would have been possible.

This dissertation is the result of a tremendous amount of work by a variety of people, for example: the archaeologists who originally recovered the skeletal remains from these Medieval Christian churches, the Museum staff who curated and supported the data collection for this project, the statisticians who assisted with the development of the models use to analyze these remains, and my dissertation committee who guided, encouraged, and supported research in an area that was lacking in previous bioarchaeological work.

I would foremost like to thank my PhD committee members: Dr. Norman Sauer, Dr. William Lovis, Dr. John Frey, and particularly, my advisor and committee chair: Dr. Todd W. Fenton for their support, advice, constructive criticism, and time. Special thanks to Exmo. Sr. Luis Lorenzo Cabo Perez of Mercyhurst College (now Mercyhurst University) and all my colleagues in Asturias, Spain. I owe a great deal to Angel Villa Vladés and his family (Carmen, Carmesita, y Lola) who have made me feel at home when I was farthest from it. If not for their generosity, encouragement, and support, this research would not have occurred. I must also thank the anthropology department graduate secretary Nancy Smith, who tirelessly kept me informed and on track throughout my tenure as a grad student at MSU. Additional thanks to the Museo Arqueológico de Asturias (located in Oviedo, Asturias, Spain), and staff, namely: Jorge Camino Mayor, Carmen Fernández Ochoa, and Belen Madriaga García. Thanks also go to Dr. Rosario Suárez Vega director of the excavations at San Julian de Viñon, and Susana Hevia

González, Ruben Montes López, and Olga Gago Muñiz from their work at the Castro de Chao Samartín.

I am eternally in debt to Doctors: Dennis C. Dirkmaat and Steven A. Symes from Mercyhurst University for first putting up with me for six straight weeks of short courses in the Summer of 2004, and then accepting me into the Mercyhurst College Masters of Science program the following year, insuring another two years of punishment. Their insight (or lack thereof), is the only reason I have been able to continue my graduate education in anthropology.

My debt to Dr. Stephen Ousley (and Erica Jones) also began in 2004 when he was still the Director of the Smithsonian Repatriation Laboratory. It was at this time that he allowed for Chris Rainwater, Jeremy Beach, Katie Frazee, Rene Lisjak, and I to be contractors at the Smithsonian National Museum of Natural History; re-housing and moving many of the human skeletal collections to the attic. While this experience was full of dust, manual labor, and chair races, it is one that allowed me to see countless human remains early in my career and helped me to realize the true scope of skeletal variation and bony pathology. Finally, Dr. Todd W. Fenton has supported me throughout the duration of my undergraduate and graduate education beginning with my first class in anthropology: ISS 220, Spring semester 2002. Without his support of undergraduates I would not have continued on with anthropology into graduate school, let alone been able to pursue a doctoral degree.

While there are far too many individuals, institutions, and friends to thank, I do feel the need to list at least some of those who I owe the honor of knowing. Thus I would like to thank (in no particular order): Jennifer “Gumma” Vollner, Christopher “Bear-awesome” Rainwater, Joseph “Ronin” T. Hefner, Natalie “Bugeisha” Ulh, Dominique “Dom-dom; Domfries; Bonesies” Semeraro, Heather “Baby H” Garvin, Dr. Christian "Kung-fu" Crowder, Carlos "Los"

Zambrano, Dr. Krista “Punk Rawk” Latham, Jeremy “Archaeologist” Beach, Amandine “Battleshark” Eriksen, Aaron "The Russian" Arlof, Dr. Martha "Kate" Spradley, Brian "Rubik's cube" Spatola, Natalie "mustachio" Shirley, Christina "shorty" Fojas, Dr. Bradley "J." Adams, Dr. Eric "The Giant" Bartelink, Dr. Angi "MFing" Christensen, Dr. Masako Fujita, Marina "Bear, Beer, Beard, y Bird" Martinez De Pinillos, Dr. Katerina “Kat” Puentes, Dr. Hugo Cardoso, Dr. Lino Assunção, Dr. Joao Pinheiro, Annie “Annabelle” Marjenin, Jeff (and Gina) "The Rusty Trowel" Illingworth, Dr. J.M. “Doc” Adovasio, Karl “Konkrete” Hedderich, Christian “Martinville” Martin, Stephen “Tank” Johnson, Faye "FayeFaye" Corgi, and everyone at Stillwater "SWG" Grill. You have all been great friends and colleagues and you are all to blame for the anthropologist I have become. To those who should be listed but were omitted, I owe you a drink or two.

Finally, I wish to thank the MSU Anthropology Department, and the Kenneth E. Corey Research Enhancement Award for financially supporting portions of this research project. The importance of financial support for graduate students and their dissertation research cannot be overly stated and neither can my gratitude for this generosity.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1. Introduction

Introduction

Iberia has a long historical record originating with the first Romans who entered the Iberian Peninsula and described the indigenous peoples they encountered there (Collins 2000; Lorrio and Ruiz Zapatero 2005). Over time, Spain's historical record grew in both diversity and detail with multiple histories of events and reigns being recorded throughout the Medieval Period by different parties with different goals (Linehan 1993; Jackson 1972). Unfortunately, as is common in Medieval histories, these documents concern only the key individuals involved in large political events. The average individual has no written history, nor are there any anecdotal summaries of what peasant life was like in Medieval Spain.

Due to this dearth of information, this project uses what is available from the historical narrative relating to issues of the economy, inferred gender, and familial status roles to investigate the biological health of those individuals excluded from written history. Here the historical narrative is used as the basis for the investigative framework regarding the bioarchaeological record (via human skeletal remains) in order to take a Historic Bioarchaeological approach to this project (Perry 2007). Historic Bioarchaeology allows for the investigation of past human lifeways within the established historical narrative, while also generating the potential for refinement of both the historical and archaeological narratives through this dynamic interplay of history, artifacts and biology. Bioarchaeology can offer unique insights into the lives of ordinary people filling in the gaps of the established historical narrative.

Although they are not the focus of most historical documents, ordinary people make up most of history, and their lives are the most representative of a society.

The purpose of this study is to investigate the impact of political and economic change on the health of people living in predominantly rural communities of Medieval Asturias, Spain. The region of Asturias is unique as, unlike the rest of the Iberian Peninsula, Asturias was never conquered or occupied by the Moors (Jackson 1972). The historic Kingdom of Asturias began ~722 AD when it became a refuge for Christians during the Islamic conquest of the rest of Spain. The Kingdom of Asturias grew in size and power until the capital of the kingdom shifted and Asturias became incorporated into the Kingdom of Leon ~924 AD. The region of Asturias was eventually incorporated into the Kingdom of Castile in 1230 AD. It was not until a rebellion in the 1300s AD that the current Principality of Asturias was fully established. This was the first step in Asturias' participation in the future Spanish Empire (Jackson 1972).

The bioarchaeological record of Asturias has never before been systematically investigated, nor has the bioarchaeology of any other Spanish region. However, understanding the bioarchaeological record of Asturias is important because of its unique history, having never been subject to Moorish rule and serving as the origination of the Christian Reconquest. Asturias can therefore serve as a baseline of comparison for future research in order to evaluate the impact of the Muslim conquest of Iberia on other local communities as well as the consequences of Spanish Imperialism in other more urban Iberian localities.

The skeletal population representing individuals from Medieval Asturias, Spain were used to investigate three hypotheses:

1. That from Phase I early (~900-1300 AD) to Phase I late (~1300-1500 AD) the frequency of skeletal stress markers (linear enamel hypoplasia, cribra orbitalia, porotic hyperostosis and adult stature) will increase in the sampled sites representing the population of Asturias during Spain's centuries of crisis. Further, this trend of increasing skeletal stress markers should continue into Phase II (1500-1800 AD). Along with skeletal stress markers, markers of infectious disease (tibial periostitis, and other infections) will also increase during the Spanish Empire (Phase II) due to increases in population density and consequent disease transmission.

2. That there would be no differences in the proportions of adult males and females, nor would there be significant differences between sexes for markers of skeletal health or mortality (via age-at-death distributions) in either Phase I or Phase II.

3. That because Medieval mortuary status is reflected in *ad sanctos* burial, skeletal markers of stress and disease would have lesser a prevalence in individuals buried within church walls than those individuals buried outside church walls. Further, those individuals buried outside church walls would have significantly shorter adult statures related to reduced access to resources during development, and that there would be a greater relative amount of subadult burials outside the churches as these limited resources may have resulted in increased frailty during childhood.

These hypotheses, based on the historical narrative for Medieval Spain, deal with how political and economic changes which affect access to resources and the spread of infectious diseases may be felt in a more rural region such as Asturias. In addition, issues related to differential access to resources for males and females due to the inherently patriarchal nature of Medieval Spanish society were investigated, as well as differential access to resources due to status as perceived through mortuary treatment.

The project hypotheses were investigated using human skeletal remains recovered from archaeological contexts within the historical region of Asturias, Spain. Unfortunately, due to the acidic nature of the mountainous soils of northern Spain, the human remains recovered from Asturias, Spain are often poorly preserved. Further, many of these sites have limited contextual documentation because of the rushed archaeological methods employed during their excavation as many were salvage archaeology projects. In light of these preservation issues combined with the fact that most of these cemeteries are from small rural villages, the skeletal collections of Asturias are thus limited by the small sample sizes for each particular site. The approach taken here to resolve these potentially confounding issues was to aggregate the small samples from each cemetery into a single regional sample. This regional sample, composed of the multiple small church cemetery samples from Medieval Asturias, Spain (n=13), was analyzed as a single entity representing the general Medieval Asturian population.

The human remains from Medieval Asturian rural church cemeteries were examined using standard bioarchaeological methods. Typical indicators of skeletal health and disease such as linear enamel hypoplasia, tibial periostitis, cribra orbitalia, porotic hyperostosis, other bony infections, and adult stature were evaluated on all available individuals. In addition, standard biological profile information relating to biological sex, age-at-death, and standard osteological measurements (Buikstra and Ubelaker 1997) were collected on all present individuals and skeletal elements. However, in order to analyze the human skeletal data within the regional framework while dealing with the issues of poor preservation and contextual documentation, a unique statistical model was required.

The statistical model employed for this project is called mixture modeling and has not been previously applied to bioarchaeological inquiry. In order to conduct these analyses, the statistical package M*plus* was chosen for a number of reasons (Muthen and Muthen 2010). First, M*plus* is inherently designed to perform mixture models while handling missing data (Muthen and Muthen 2010:8) and thus resolving many potentially problematic issues resulting from the poor preservation of much of the skeletal material. Second, M*plus* performs latent class analysis. Latent class analysis is a Frequentist form of cluster analysis and was utilized here in order to generate probability statements for sex classifications and investigate potential site outliers. Third, M*plus* serves to combine the latent class analysis results with ordinal logistic and least squares regression analyses into a single mixed statistical model. These three characteristics are essential to the success of the current project's regional approach to historical bioarchaeology due to their flexibility in sample composition and combination of statistical methods.

The statistical analyses found there to be no statistically significant changes in the biological health of individuals living within the region of Asturias, Spain throughout the Medieval period. In addition, despite the patriarchal nature of Medieval Spain, there do not appear to be statistically significant health differences between male and females individuals. Finally, while *ad sanctos* mortuary treatment was practiced throughout Spain during the Medieval period, the status differences between individuals buried within churches and in the common church cemetery do not appear to be statistically significant.

The conclusions from this project serve to demonstrate multiple points regarding the bioarchaeological record of Medieval Asturias, Spain and how this may affect future interpretations of Asturias' historical record: (1) despite economic and agricultural crises elsewhere in Spain, the individuals in Asturias do not appear to have suffered from growth stunting or diseases associated with immunosuppression as is often the case with malnutrition, (2) any differences in the availability to nutrition or healthcare between males and females were minimal (3) any differences in the availability to nutrition or healthcare between common peasant individuals and higher status individuals determined via *ad sanctos* burial were not significant enough to appear in the skeletal remains, and (4) the statistical modeling developed for this project was successful in dealing with missing data due to difficult sampling conditions, determining latent classes of variables, and conducting regression analyses. These findings set the stage for future investigations of health and disease in Asturias, Spain as well as throughout the Spanish colonies. While much additional work could be done in Asturias to expand the present study sample, this would require a great deal of excavation at other rural church cemetery sites. However, there are numerous skeletal samples currently available from other regions of Spain as well as from the Spanish colonies in the New World which can be investigated for relative fluctuations in health and disease in relation to the present Asturian sample as well as the historical narrative. Only through additional analyses and similar historical bioarchaeological projects can the full history of the ordinary individuals of Asturias be written.

Structure of the dissertation

Chapter Two discusses the development and current state of the field of bioarchaeology. In addition, the chapter summarizes the bioarchaeological sub-disciplines of paleopathology and paleodemography, both of which are important aspects of this project. However, while the chapter serves as an introduction to the discipline as well as a discussion of how bioarchaeology functions, the chapter also highlights the types of questions which can be addressed using a *biocultural approach* to skeletal remains recovered from archaeological contexts. The biocultural approach is able to bind human skeletal biology to other relevant cultural systems which act as potential buffers between individuals and their environmental stressors. Through this lens, indicators of skeletal health can then be examined in a more holistic context working as part of a larger system towards attaining net nutrition levels or disease prevention and treatment (Goodman et al. 1988).

Chapter Three attempts to briefly capture the main historical points resulting in the original creation of the Kingdom of Asturias in ~722 AD and follow the development of Asturias throughout the Medieval period into the rise and fall of the Spanish Empire. Key points include: the Spanish reconquest of Moorish controlled Iberian territory, the Medieval Crisis, outbreaks of the bubonic plague, and the Seventeenth Century Crisis (Lomax 1978; Mackay 1977; Ruiz 2007).

Chapter Four summarizes the development and expansion of Christianity in Spain, focusing on the role of the Church and mortuary treatment of the deceased. The important focus in this chapter is the discussion of the development and persistence of *ad sanctos* burial or the tradition of treating socially prestigious burial locations as a highly prized commodity in the Medieval Christian world (Naji 2005). *Ad sanctos* burial may then be used as an avenue to infer social status of individuals via their burial location due to these particular mortuary customs which were widely practiced in Spain and other areas of Western Europe throughout the Medieval and Empire periods (Bango Toviso 1992).

Chapter Five details the three research hypotheses specifically addressed by this project. In addition, this chapter discusses the specific historical and archaeological data upon which these hypotheses were based and how these research questions were approached via the skeletal remains of Medieval Asturian peasants. Hypothesis One deals with potential change in skeletal health over time as a function of changing political and economic situations, Hypothesis Two deals with issues of biological sex and differential treatment of gender roles, and Hypothesis Three deals with *ad sanctos* burial and status differentiation via mortuary treatment.

Chapter Six discusses the specific materials used to investigate the three aforementioned research hypotheses. Specifically, the human skeletal remains from 13 previously excavated Christian church cemeteries that were examined using standard bioarchaeological techniques in order to generate demographic data. The inclusion of multiple sites and a range of skeletal variables along with the collection of general skeletal stress data allowed for accurate assessments of population health by site, time period, inferred status based on burial location (*ad sanctos* burial), and region (See: Steckel et al. 2005; Perry 2007). A general two-phase chronology will be used to help cluster and simplify sites by time period.

Chapter Seven covers the specific methods used to score the human remains utilized in this project, most of which are standard practice in bioarchaeological data collection. In addition to the variable scoring, this chapter details the statistical methods proposed for this project, both of which rely on the use of maximum likelihood estimation and support the inclusion of cases with missing data. The application of these two statistical methods (latent class analysis and mixture modeling) is unique to this project for the field of bioarchaeology and thus an extended discussion of their utility and application was included as necessary.

Chapter Eight details the results of all the statistical tests for each hypothesis. Point by point each statistical analysis and output is reported for each hypothesis along with a brief explanation of the statistical significance of the test results.

The final chapter (Chapter Nine) discusses the results of the hypothesis testing and the implications concerning current interpretations of Medieval Asturian biological health. In addition, project limitations and directions for future research are mentioned in this chapter. It would appear that biological health in Asturias, Spain changed little throughout the Medieval and Spanish Empire periods. Further, there are no significant differences between biological sexes, nor does *ad sanctos* burial as a status marker appear to have any relationship to health or mortality.

Chapter 2. **Bioarchaeology**

Introduction

As a field, bioarchaeology has only existed since the late 1960s with its roots in Processual Archaeology as popularized by Binford (Wright and Yoder 2003). As a result, a clear definition of this hybrid study has not yet been established. According to Larsen (1997), bioarchaeology may be broadly understood as the combination of archaeological and osteological data in attempt to better understand peoples, cultures and cultural phenomena through the archaeological record. As such, it is generally assumed to encompass the fields of paleoepidemiology, paleopathology, and paleodemography, all of which rely on the postmortem (typically skeletal) remains of humans to infer characteristics back to the population the remains came from (Hoppa 2002). At the same time though, skeletal remains from archaeological contexts were being analyzed long before the field as it is understood today originated. Bioarchaeology is unique in its direction from other current fields of skeletal study; the main contemporary of which in the United States is forensic anthropology. Forensic anthropology is primarily concerned with the individual (in medico-legal contexts) and the ability to extrapolate as much data as possible from the single unknown skeleton in relation to the general associated population (Dirkmaat et al. 2008). Bioarchaeology on the other hand, is more interested in following trends and seriating a sample in order to rank individuals and reach the best fit of all of the skeletons in the sample to create a population. The goal here is to reproduce parameters of the larger population in reference to itself (the actual sample present) as accurately as possible (Landau and Steele 1996). In a sense, bioarchaeology is more concerned with patterns *of* individuals, while forensic anthropology is much more concerned with patterns *from* individuals.

The practice of bioarchaeology has an inconsistent history as the scope and focus has not always been constant, nor have the analytic interpretations. Historically, statements of great impact were often made from the examination of only a few skeletal elements or artifacts (see Johnson 1972 and references therein). It was not until the mid-1960s that the examination of skeletal remains from archaeological sites transitioned to more population-based examinations and interpretations (Wood *et al.* 1992). The roots of this transformation lie in the adoption of practices from the New Archaeology or Processual Archaeology, as popularized by Binford in the 1960s (Wright and Yoder 2003). The main goal of processual archaeology is to enhance archaeological data and techniques using the scientific method and statistics (Johnson 1972). Arguably, the turning point in the study of human remains was research by Armelagos (1969), which illustrates a shift from the previous descriptive and speculative work, to the more problem-based inquiry advocated by processualists.

Today bioarchaeology most often entails examining samples of skeletal data in their own cultural-historical contexts and inferring conclusions based on these data. These skeletal analyses are therefore more rooted in an archaeological framework (Wright and Yoder 2003). Wright and Yoder (2003) note that the ramifications of the conclusions made by bioarchaeologists about past populations have a number of impacts on scientific work or the culture of living descendants depending on the context of the cultural association. Thus, it is important that bioarchaeologists make correct assessments of their data and that their conclusions be supported. In addition, bioarchaeology as we understand it exists predominantly in the United States, where the term was originally coined (Buikstra 2006). In Europe for example, the field is more often referred to as "osteoarchaeology" and traditionally deals with the classic roots of European cultures by analyzing human *and* nonhuman skeletal remains. Whereas, in the United States nonhuman remains are usually analyzed by zooarchaeologists.

In efforts to make bioarchaeology more scientific as well as less culturally sensitive following the advent of processual archaeology, the "New Bioarchaeology" has relied more heavily on the use of statistics as a measure of significance and validity (Buikstra and Cook 1980). While this new trend is to the dismay of many bioarchaeologists and anthropologists alike, Thomas (1978) notes that statistics are very much a part of data interpretation. Because statistics can be understood as the closest approximation or best model of reality that exists (Stephen Ousley, personal communication 2007), they are necessary in any endeavor which uses a sample that is assumed to be from, or being tested as a reflection of, a larger group or population.

The increasing reliance of scholars on statistics and scientific rigor has also led to the development of the controversial "osteological paradox" (Wood et al. 1992). Wood et al.'s (1992) basis for the osteological paradox are three core principles: demographic nonstationarity, selective mortality and hidden heterogeneity. These principles serve to demonstrate the potential paradox of conclusions drawn from human skeletal remains from archaeological contexts, and that because bioarchaeology is considered a scientific discipline with the potential to reveal a tremendous amount of culturally sensitive information about past population lifeways (Landau and Steele 1996), Wood et al. call for more cautious interpretations from these remains (Wood et al. 1992). Fortunately, the osteological paradox has been presented in order to make bioarchaeologists more cautious in their interpretations, and thus increase the strength of our conclusions of archaeological remains, a goal which is still prevalent in bioarchaeological literature today (Wood et al. 1992). On the other hand, in support of the osteological paradox, recent work by Wilson (2010) demonstrated that individuals who exhibited skeletal lesions were in fact those more prone to early mortality, thus giving credence to the long held belief that bony reactions are associated with morbidity and that the osteological paradox may not be as theoretically problematic as once assumed.

While bioarchaeology has come a long way as a constantly evolving discipline, it is not without critiques. For instance, Goldstein (2006) suggests that the multidisciplinary approach to bioarchaeology through mortuary archaeology has yet to really be implemented as a standard. While Goldstein's critique is likely valid, this may actually reflect an overall lack of multidisciplinary work in archaeology as a whole. Rarely are archaeological projects funded to the degree that they can support multiple outside experts, and dissertation research (funded or not) is often conducted by a single graduate student guided by their committee, thus limited the opportunities for multidisciplinary team projects.

Paleopathology and paleoepidemiology

Paleopathology and paleoepidemiology are two closely related subfields within bioarchaeology which focus on the identification and interpretation of pathological and diseased conditions of skeletal material from archaeological contexts. Paleopathology is the identification and interpretation of infection, disease, and pathological variations in human skeletal remains (Cook and Powell 2006; Mann and Murphy 1990), while the aim of paleoepidemiology is to make general statements about disease characteristics of a population based on observations made from a group of skeletons which is considered a subset of that population (Waldron 2007:27).

Paleopathology studies are conducted at both the individual and populational levels. In addition, paleoepidemiology specializes only in diseases while paleopathology ranges from congenital disorders to cultural phenomena (e.g. cranial deformation). Further, paleopathology is more heavily referenced as the primary field of study concerning pathological and diseased conditions in past human skeletal remains and because of this, paleopathology will be the primary field referred to concerning disease and pathology in this dissertation.

Paleopathology first began in the 1800s as the study of pathological conditions in extinct fossil vertebrates, but over time has evolved into its current status as an interdisciplinary science focusing on human remains (Cook and Powell 2006). The study of human disease and pathology in past populations allows for a great number of inferences to be made regarding biological health in relation to environmental and cultural adaptations. However, due to preservation issues, we must rely largely on skeletal materials and this creates a disconnect between those chronic diseases that affect the skeleton and those that do not. Most infections do not present in skeletal remains unless they are chronic conditions and many chronic conditions do not have skeletal features that are pathognomonic. This lack of diagnostic features (often associated with non-specific stress markers) may lead to a difficult *differential diagnosis,* or the classification of a pathological state via similarities and differences to known conditions based on the morphology of observed lesions. Differential diagnosis relies on knowledge about both the context of the individual and the pathogenesis and epidemiology of potential disease states (Ortner 2003). Often seemingly minute differences can lead to the diagnosis of one condition or etiology over another. Once a diagnosis is made, the interpretation of the etiology is often the most anthropologically important finding, particularly with nonspecific stress markers.

Some recent scholars have begun to suggest that more important than a diagnosis for a pathological lesion, is the explanation and understanding of the disease process in the remains themselves (Brian Spatola 2011 Personal Communication). This stems from the fact that the human body can only respond in so many ways in attempting to maintain homeostasis when confronting pathological conditions and many of these responses are non-specific. For example: the broad concept of physiological stress can manifest itself a number of ways which are often termed non-specific stress indicators (Goodman et al. 1984; Buikstra and Cook 1980). These general indicators are considered to be very informative in relation to nutritional deficiencies and anemic responses in terms of populational health and homeostasis.

The primary model applied to health in archaeologically derived populations (often referred to as the biocultural approach) uses the concept of Selyean stress (Goodman et al. 1988; Goodman 1991); where the environment is the source of resources necessary for survival as well as factors which adversely affect adaptation. Thus stress is considered any "extrinsic variable or combination of variables that causes an organism to react" (Buikstra and Cook 1980:444). Cultural systems then act as potential buffers between individuals and environmental stressors. Through this lens, indicators of skeletal health can be examined in a more holistic context working as part of a larger biocultural system (Bush and Zvelebil 1991). In addition, Cohen and colleagues (Cohen and Williamson 1991; Cohen 1998) argue that morbidity and mortality in human populations are linked to psychosocial stress. The specific the etiology of psychosocial stress is therefore contextually based. Thus, without detailed study of the population, which is often impossible via archaeologically derived skeletal remains the causes of observed pathologies are often unclear.

Recently, a large scale project was undertaken to document paleopathological traits in skeletal and dental remains from archaeological contexts across the globe. This Global History of Health Project (GHHP) (global.sbs.ohio-state.edu), developed out of a similar initiative based solely on the Western Hemisphere (Steckel and Rose 2002) with the goal of creating large databases to reinterpret the history of human health (Steckel and Rose 2002). Much of the approach taken in this dissertation project was developed from the GHHP data collection protocols. While the final data collection protocols used here differ slightly from the GHHP protocols (see Chapter 7), they are backwards-compatible. In addition, the use of the GHHP's Health Index as a relative score for health is used here for comparison to these sites on a more global scale (Steckel et al. 2002).

Paleodemography

Paleodemography can be defined as "the field of inquiry that attempts to identify demographic parameters from past populations derived from archaeological contexts, and then to make interpretations regarding the health and well-being of those populations" (Hoppa 2002:9). While inherently tied to bioarchaeology, paleodemography attempts to answer demographic questions about the past, most often by using human remains from archaeological (cemetery) contexts. The reason paleodemography is so important for bioarchaeology, is that paleodemographic analyses attempt to reconstruct the demographic profile of the living population, from which the cemetery population is derived. Essentially, if the structure of the living population can be reconstructed, then a number of biocultural questions can be addressed dealing with the make-up of that cemetery population (Acsádi and Nemeskéri 1970; Hoppa 2002). Further, the demographic profile from a known span of time can be used to extrapolate additional information about the history (and possible future) of a population, allowing bioarchaeologists to gain insight into such topics as the settlement of a region, reasons for populational growth/decline, health, and interaction with other regional populations.

All paleodemographic analyses are based on age distributions by sex of a given population and therefore require these parameters to be estimated as precisely as possible. Because of the nature of error rates associated with these parameters, paleodemographers must make at least one assumption prior to any paleodemographic analyses: that the cemetery must at least be “typical” of the population it came from, meaning the estimated sexes and ages of a skeletal population *reflect* those of the living population from which they are derived (Waldon 1991: 24). In general, this assumption is well founded as most cemetery populations should reflect the typical population, in death, that the remains are derived from. Discrepancies between the cemetery and living populations are often the result of mortuary practices reflecting different cultural perceptions regarding death. Any possible biases affecting the postmortem population composition and representation of living populations from which they derive, can typically be discovered in early analyses or via historical records and thus accounted for in future analyses (Hoppa 2002).

In the last decade it has become commonplace for paleodemographic analyses to rely on hazard modeling. Hazard modeling attempts to use statistical models of age-at-death distributions to generate trends in mortality based on likelihoods of survivorship (Wood *et al.* 2002). While well founded and statistically sound, the major caveat of hazard models is that they require an appropriate known-age reference sample to for unknown target sample (Konigsberg and Hermann 2002). Because appropriate known-age samples are not frequently available, this heavily restricts the utility of hazard modeling. Recently, work by Uhl and Passalacqua (2009) demonstrated that simple age seriation methods (here using only the innominate and skull) were able to reproduce the mortality structure of the target population better than (typically forensic) point age estimates for each individual. The utility of this method is the ability to reproduce the overall mortality structure without the need for a known reference sample, unlike hazard models. However, this method can only performed on a population of individuals, lacking single individual age estimates and it not as statistically grounded as hazard models. Due to the lack of appropriate known-age reference samples from this region and time period, seriation methods for modeling age-at-death distributions were chosen for this project based on the results of Uhl and Passalacqua (2009) (see Chapter 7).

The Present Study

This bioarchaeological project investigating issues related to health and demography of Medieval Asturias, Spain via small church cemetery populations, will combine standard protocols from paleopathology and paleodemography. Specifically, paleopathological indicators of developmental stress and infectious disease and paleodemographic indicators of subadult frailty will be used to investigate questions regarding political and economical changes over time within the region of Asturias, Spain. While the combination of paleopathological and paleodemographical methods is common in bioarchaeological research, what uncommon is the *regional* approach taken here. While regional approaches to bioarchaeology appear to be increasing in recent years as our statistical methods and understanding of skeletal biology becomes more refined (e.g. Tung 2003; Andrushko 2007), Armelagos (2003:30) actually sites the early regional approaches to bioarchaeological work taken by Cook, Buikstra, and Larsen as a major development within the history of bioarchaeology. Armelagos (2003) further suggests that these regional approaches demonstrate the full potential of bioarchaeology as a tool to investigate the archaeological record of human past.

Here the utility of taking a regional approach to bioarchaeological investigation is the ability to examine multiple small Christian rural village church cemeteries from the historically and politically defined region of Asturias in order to approach the Asturian peasant population as a whole. When dealing with an aggregation of archaeological sites it is important to have a well defined region, much like Asturias, which was an integrated and long standing political unit (originating ~720 AD). Here, as in other regional projects, the hypotheses and analytical implications are being applied to the aggregate sampled population from all of the sites analyzed which is key as this is not a site level analysis, although inferences from the regional scale can inform interpretations at individual sites (specifically: detecting outliers).

Chapter 3. A History of the Iberian Peninsula and Asturias, Spain

The Fall of the Western Roman Empire and the Late Antique Period (~400-700 AD)

A proper understanding of the political and economic development of Medieval Spain and the Spanish Empire necessitates a discussion beginning at least with the fall of the Western Roman Empire. This is primarily due to the fact that the arrival of the Christian Visigoths in the Iberian Peninsula represents a significant change in the character of the region. According to Heather among others (namely: Collins 2000), the Visigoths were a Germanic tribe probably originating in Scandinavia who, after being displaced from their homeland by the movement of the Huns onto the great Hungarian plain, invaded the Roman Empire. This displaced group invaded the Greek, Italian, and Iberian peninsulas and were eventually responsible for the sack of Rome in 410 AD. Given the extent of the devastation they left in their wake, it is likely that these Gothic invasions brought about the eventual fall of the Western Roman Empire. For these Gothic invasions also set off a chain of events that resulted in the invasion and occupation of Iberia by other Germanic peoples such as the Alans, Sueves, and Vandals (Heather 2006). The Visigoths eventually settled in Iberia, taking control of the Roman provincial governments and displacing these other barbarian invaders. They successfully occupied these lands until the Moorish invasion in 711 AD (Collins 2000) and this period of Visigothic occupation is commonly referred to as the Late Antique Period of Iberia (Collins 2000).

There is some dispute as to what actually occurred once the Visigoths established power in Iberia. For example, the religious beliefs of the Visigoths were an early source of conflict. Tierney (1978) explains that the Visigoths were an elected monarchy that practiced Arianism, a popular form of Christianity in the 4th and 5th centuries AD, but one which was eventually deemed a heresy. In contrast, the indigenous Iberian population was largely Orthodox in Romanized areas and while violent conflict did not arise, this Hispano-Roman population did not fully support the new Visigothic regime. These conflicting views appear to continue until ~589 AD when the Visigothic King Reccared converted to the Nicene orthodoxy and the practice of Arianism began to disappear from Iberia (Paxton 1990).

All the same, it would appear that the Visigoths took a very practical approach to ruling this newly conquered region. Heather (2006) supports the view that when the Visigoths began exerting control over Iberia around 473 AD, they actually left the previous Roman system of government in place and simply substituted their own royalty for the Romans who had previously been in positions of power. This may have allowed for a potentially smooth transition of power which would go unnoticed by rural populations for some time (Kulikowski 2004).

On the other hand, while the Visigoths may have assumed Roman positions of power, they did not continue to carry out many functions that powerful Roman aristocrats had performed as part of their civic duty. Historical sources note the Visigothic basis for power appears to have been a proto-feudal system with regional differences between provincial leaders who theoretically supported a central figure (Bowes and Kulikowski 2005; Stocking 2007). Heather (2006) and others (Collins 2000; Carr 2005) demonstrate that this proto-feudal system created much infighting which resulted in multiple civil wars among the Visigothic aristocracy throughout their reign. Further, while the historical sources suggest that the Visigoths simply took over for the Romans and Iberian life continued without much disruption, archaeological data shows that the overall quality of life for peasants dropped significantly throughout the Visigothic (Late Antique) period. Carr (2005) has argued that this decline was likely due to the collapse of the Spanish olive oil industry and long distance trade networks. Once this began to occur, the upkeep of the cities and public works by aristocrats ended, and many jobs or sources of alternative income for farmers were lost as cities and roads fell into disrepair. Some historical sources (Bowes and Kulikowski 2005) note that at this same time, there is a major shift of both Hispano-Roman elites moving into rural villas from the cities and the use of waterways as the main form of trade and transportation instead of the Roman road system.

The Construction of Medieval Iberia (~700-900 AD)

Scholars agree that during a prolonged Visigothic civil war in 711 AD, groups of Arabs and Berbers from North Africa invaded Iberia via the Straits of Gibraltar and quickly conquered most of the peninsula as part of the overall process of Islamization (Lomax 1978:25). Lomax (1978) suggests that these Moorish leaders paid little attention to the rural mountainous regions of northern Iberia and instead focused on a military push through the peninsula and into modern day France. This French expedition would inevitably prove disastrous for the Moors as the main party of Moorish forces were defeated by Frankish forces led by Charles Martel in 732 AD (Lomax 1978).

Likely due to the fact that these Moorish invaders had their sights set on the Frankish kingdoms, only a small Moorish detachment was sent on a military expedition to the Iberian region of Asturias in 718 AD. While many of the actual details of this expedition are unknown or else subject to dramatic embellishment in the histories, it is clear that the Moorish forces were defeated by the Asturian forces at Covadonga (Mackay 1977). This loss may have had a significant impact on the Islamic conquest and for some marks the beginning of the Christian reconquest of the Iberian peninsula. As Linehan states, "It was with the mountain people of the north themselves that the conquest of Spain *and of the whole world* [author's italics] had originated" (Linehan 1993:14).

The first written histories of Asturias (from ~911 AD) report the Christian defense of the region was led by Pelayo, an Asturian of Visigothic descent. Modern day historians such as Lomax and Gerli suggest that shortly after this event, a no-man's land formed between the Muslim and Christian Iberian territories, as nobles and urbanites fled to more secure cities within the respective territories. According to Gerli (2003), the reconquest began as a series of long-distance raiding parties that intermittently sacked and destroyed Islamic controlled Iberian towns, which in turn resulted in their abandonment and an increase in the size of the borderlands. These borderlands served not only as a buffer between Christian and Muslim territory but also as the point of origin for the slow process of Christian reconquest. For the repopulation of these original Christian cities that were abandoned due to raiding, led to additional Christian raids and the slow movement of the border lands into Moorish territory (Lomax 1978:27).

The Development of Medieval Iberia: The Kingdoms of Asturias, Leon, and Castile (~900-1300 AD): <u>Project Phase I Early</u>

It should be noted at the outset that while the reconquest began immediately after the initial defeat of the Moorish forces by Pelayo at Covadonga, it was not an official campaign with the specific goal of eliminating the Islam from Iberia until after 1000 AD. Further, once the reconquest became established it was widely seen as a crusade against Islam and patronized by Pope Innocent III (Mackay 1977). Grabow (2010) argues that while some may have been concerned about the Islamization of Iberia, in reality the reconquest was mostly economically driven and heavily supported by the Franks, as well as other kingdoms. Moreover, pilgrimages, especially the journey to the city of Santiago de Compostela reached their height of popularity in the 1100s AD and with pilgrims came money, settlers, trade networks, and new constructions (namely monasteries).

Along with the emergence of the new Christian kingdom and an initial rapid expansion of Christian controlled territory, the Spanish political structure (both size and complexity of government) and societal infrastructure (construction and maintenance of road systems, buildings, etc.) also increased, but at a slow pace. References to unmaintained roads and supply lines are a common theme in the histories documenting the military campaigns of the period (Lomax 1978).

The reassertion of Christian influence and the reconquest of the Iberian peninsula did not always require direct military conflict. Around 1000 AD, the Islamic kingdom (*caliphate*) collapsed into multiple *taifa* (party) kingdoms. Each taifa kingdom was ruled by different ethnicities from the original invading cohort (e.g. Egyptian, Syrian, etc), with the strongest being the North African controlled Granada (Mackay 1977). Throughout the duration of the taifa kingdoms, their rulers (*emirs*), were often in opposition to each other. Not only were they hostile through military action, but they also competed for cultural prestige; trying to recruit poets and artisans from other taifa kingdoms (Mackay 1977).

In order to protect themselves from their often hostile Islamic neighbors, these taifa kingdoms formed client relationships with the northern Christian kingdoms. Such alliances resulted in immense wealth being transferred from Muslim to Christian lands through patronage (*parias*) and Christian military pressure (Mackay 1977). With the accumulation of Christian wealth and the increasing momentum of the reconquest, the capacity for population sustainability and resource distribution increased. The economic system in place further facilitated these changes, because it allowed Christian soldiers to gain land for agriculture and livestock, increase their social status through acquiring booty, and ultimately control markets and the means of production (Mackay 1977; O'Callahan 2003).

As the processes of consolidation and expansion of Christian territory through the Iberian Peninsula continued, the political and economic stability in Asturias was improved by the transfer of the Asturian court from Oviedo to Leon shortly after city's recapture by the Christians ~914 AD (Linehan 1993). Lomax (1978) suggests that during this period, the region of Asturias was treated as a principality of the throne of the new Kingdom of Leon, but whatever its political status, Asturias now begins to take a back seat to most large political events and disappears from most historical texts as a Christian Iberian power-base.

The Medieval Iberian Crisis and Asturias (~1300-1500 AD): <u>Project Phase I Late</u>

According to Mackay (1977) following the elimination of most taifa states (except for Granada which lingered as a client kingdom into the 1400s AD), Christian Iberia fell into a period of civil war and conflict often referred to as the *Medieval Crisis*. This period of crisis would linger on until the beginning of the 1500s AD and the emergence of the Spanish Empire. The early problems arose from French and English interference in Iberian dynastic affairs as part of the Hundred Years War (Mackay 1977) which resulted in many problems of dynastic inheritance and infighting in the Spanish kingdoms of Aragon and Castile. In addition, the Black Death first struck Spain in 1348 AD and led to general population losses (as great as 60% in some areas), which in turn caused famine in areas where there were not enough healthy laborers to tend the fields (Mackay 1977; Benedictow 2004). These food shortages became particularly common in the more southern regions of Iberia, exacerbated by climatic changes leading to shorter, wetter summers and colder winters resulting in decreasing crop yields and widespread famine (Ruiz 2007). Finally, economic recession began in the second half of the 1300s AD likely due to labor and wage problems and monetary debasement (Mackay 1977:171; Ruiz 2007). This debasement occurred in part from financial insecurity with bankers and merchants restricting their investments as well as inflation (Mackay 1977).

Mackay argues that much of the actual social unrest of the time came about due to income crises for the noble and ecclesiastical lords. According to this theory, political confiscations of wealth and an abundance of feudal land (particularly in Castile) that lacked sufficient manpower to make it profitable, led to small rebellions throughout the Spanish regions (Mackay 1977:174). Interestingly, religion also played a factor. Mackay (1997) discusses how at the time, Jews were banned from holding political offices in a Christian kingdom; however *conversos* (Jews converted to Christianity) were able to advance politically. Unfortunately, as small hunger riots began to breakout during the late 1400s AD, the Jewish shop keepers and financiers came to be victims of a spreading anti-Semitic ideology. As urban unrest began to be directed at both the Christian monarchy and the Jews, the nobility set up the Spanish Inquisition in 1478 AD in order to reaffirm their power. This eventually resulted in the construction of a caste-like system operating under the idea of purity of blood (*limpieza de sangre*) and the expulsion of the Jews from Spain in 1492 AD (Mackay 1977).

By the time the Islamic kingdoms were finally defeated in 1492 AD, there were three independent but associated Christian kingdoms: Portugal, Castile, and Aragorn (Lomax 1978).

Throughout the Medieval and Empire periods, the Principality of Asturias was located within the Kingdom of Castile. These kingdoms developed out of the original Asturian Kingdom as a result of inheritance, marriage, and conquest from monarchical power (Jackson 1972).

The Emergence of the Spanish Empire: Asturias in the Spanish Empire (~1500-1800 AD):

Project Phase II

Historical tradition holds that the Spanish Empire began with the discovery of the New World in 1492 AD but lasted only a few hundred years before it collapsed due to economic decline (Ortiz 1971; Kamen 2005). According to Kamen (2005), the Spanish Empire was actually the first global empire, with possessions that by the 1600s AD would come to include the Americas, Europe, Africa, and Asia. Just as in the case of the previous Medieval Period, this new Spanish Empire first witnessed a period of economic expansion and prosperity often referred to as the "Golden Age", which was followed by a period of economic and demographic troubles known as the "Seventeenth Century Crisis" (Kamen 1991; Lynch 1992; Ortiz 1971). The "Golden Age" of the Spanish Empire was brought about by the discovery of the New World and Spanish colonization and exploitation of these new peoples and resources. However, in addition to the economic rebound, this was also a period of Spanish history known for its arts and literature, much of which corresponds with the rise and fall of the Habsburg's control of Spain.

Interestingly, this "business empire" was created not simply through exploitation, but also involved the economic interests of other invested nations (e.g. Germany, Italy, China) as well as the conquered peoples of the Americas themselves (Kamen 2003). Essentially, Kamen (2003) argues that the Spanish Empire was successful due to its ability to control the production and distribution of resources. Through this control, other foreign nations were able to invest in particular Spanish ventures, which allowed for profit both Spaniards and foreign investors. Further Kamen (2003) suggests that much of the technological innovation (affecting agriculture, industry, etc.) that allowed for the Spanish Empire to be profitable actually came from other European nations. This meant that once the Spanish Empire began to falter, other European nations were only partially invested and able to avoid involvement in the Spanish crisis through other endeavors.

In general scholars have concluded that the Seventeen century was a period of crisis for the Spanish Empire (Ortiz 1971; Kamen 1991; Lynch 1992). They have done so on the basis of historical documentation citing poor harvest yields, increases in handouts to the poor, and episodic re-occurrence of the Black Death (Kamen 1991:223; Lynch 1992:174). In addition, Kamen (1991:100) argues that due to poor harvest yields, the consequence of inflation for consumers was a decrease in the standard of living so that both rural and urban areas of Castile were affected. Contemporary historical records suggest a loss of almost 20% of Spain's population from ~1590-1650 AD, but even after these events, Spain's population continued to decline, likely as a function of unsanitary conditions in urban areas. These poor urban conditions were likely the result of overcrowding as well as abnormal rainfall and temperature fluctuations (Ortiz 1971).

Some historians suggest that the beginning of the 1700s AD offered some respite from the previous Seventeenth Century Crisis. For instance, baptismal records demonstrate that after the 1660s AD, birth rates throughout Spain began to rise and by the mid-1700s AD, population levels were similar to those found before the Seventeenth Century Crisis (Kamen 1991:270). Further, Marichal (2007) proposes that the Spanish Empire experienced a resurgence in the mid-

1700s, mostly due to taxes and loans from their Spanish colonies in the New World, particularly from Mexico.

Other scholars however, suggest that the beginning of the end for the Spanish Empire had already begun by the mid-1700s. This decline was due to the general industry of Spain, which was in a "sickly state" in comparison to many other contemporary Western European nations (Ortiz 1971). This was largely due to the fact that Spain's main exports of wine and olive oil were in decreasing demand due to increases in foreign competition, as was also the case for Spanish wool. Additionally, while Marichal (2007) suggests Spain attempted to recover economic losses from its New World colonies, it would appear that in reality the Spanish Empire over-taxed their colonies, leading to an increase in prices and decrease in living conditions (similar to the earlier Medieval Spanish Crises), which eventually led to Spain’s decreased military and naval strength. Particularly due to the decline in its naval power, the Spanish Empire lost control of its colonies as a source of revenue by the mid-1800s (Ortiz 1971). Finally, these taxes were not enough to avoid an eventual imperial collapse, and by 1810 AD the Spanish Empire was essentially bankrupt (Marichal 2007).

Asturias within the greater Spanish historical narrative

Asturias itself has very little available historical documentation with respect to the Spanish Medieval and Empire periods. Moreover, those historical narratives that do exist predominantly focus on the workings of a few politically influential individuals and pass over the vast majority of the Asturian population in silence. These limited historical sources, together with the relative isolation of Asturias, result in the inability to relate much of the historical tradition of Asturias to a larger western European narrative. As such, Linehan states: "students of Medieval Spain wrestle with the scant and rebarbative sources of their subject without the assistance of a standard lexicon of historical discourse or any generally accepted conceptual framework (Linehan 1993:20)."

The previous sections recounted the history of northern Iberia from the fall of the Roman Empire in Spain through the origins of Asturias, to the Spanish Medieval period which ended with the major socio-economic revolution and the creation of the Spanish Empire. Because the principality of Asturias became a distant location in terms of most of the major Iberian events after 900 AD, much of that narrative can be considered a general guide to the inner workings of the region. Yet because many of these larger events began in the more southern and populous urban areas of Medieval Spain (e.g. Madrid, Toledo), then spread throughout the distant rural areas, we can expect that the history of Asturias may not always have experienced change at the same moments as the rest of Spain. For example, Ruiz (2007) notes that while the kingdom of Castile was fairly stable during the Medieval Crisis compared to other Iberian kingdoms, Asturias may have prospered more than many other Spanish regions even within Castile as: "villages on the plain, where violence and plague could move swiftly from one location to another, suffered a higher rate of depopulation than fairly isolated and difficult-to-reach mountain hamlets (Ruiz 2007:33)."

The Early Medieval Period (~900-1300 AD; Project Phase I), roughly translates to the rise of towns and economic complexity throughout the Iberian Peninsula with increases in artisans and trade routes, as well as the minting of money. Yet, at this same time due to its remoteness and the immediate but slow progression of the reconquest after 711 AD, the region of Asturias was never really on the frontier between the Christian and Islamic Kingdoms and thus never had to suffer from Moorish raids or depopulation (MacKay 1977:11, 36). This was likely an initial benefit for the emerging Kingdom of Asturias as rather than fighting to defend their own borders, the Christians immediately began to accumulate land and wealth from their expanding military efforts. Because of these consistent increases in wealth, despite the shift of the capital from Oviedo to Leon, it would appear that Asturias continued to prosper throughout this period.

The Late Medieval Period (~1300-1500 AD; Project Phase I Late) corresponds to the era commonly known as the Christian Crisis; when civil wars, famine, decreased military action, economic decline, and Iberia's first encounters with the Black Death (affecting trade and demography) lead to overall decreases in the Spanish economy and population (MacKay 1977; Ruiz 2007). Similar to much of the rest of the Iberian Peninsula, Asturias, too suffered from this crisis as the Black Death spread throughout all the regions of Spain (Benedictow 2004). The Black Death first appeared in the Southwest (via Mallorca) and Northeast (in La Coruña) of Spain in late 1347, arriving through transportation via ship (Benedictow 2004). However, from there it spread with Asturians suffering from the Plague by November 1348, and all of Spain suffering from cases of the plague in less than two years (Benedictow 2004). Additionally, changes in climatic conditions effected crop yields everywhere (Ortiz 1971), and while the economic trouble appears to have begun in the more southern areas, these too were soon felt in the north (MacKay 1977).

While the late Medieval period was plagued by crisis, the following Spanish Empire Period (~1500-1800 AD; Project Phase II) was characterized by an early era of economic prosperity for the whole of the Iberian peninsula. Unfortunately, for the most part, this tranquility was short lived and abruptly followed by a period of economic crises and slow deterioration eventually resulting in collapse of the empire (Kamen 1991; Lynch 1992). Yet throughout the Spanish Empire period, little appears to have changed in Asturias compared to the late Medieval period (Kamen 2005). Most inhabitants were still rural villagers and the population of Asturias remained comparatively low in contrast to many of the more southern urban Spanish areas (Kamen 2005). It is unclear how much of the economic upturn from emergence of the Spanish Empire may have affected Asturias. While some authors (Kamen 2005:244; Lynch 1992:8) suggest populations rose in northern Spanish regions, it is possible that the problems affecting Asturias at the end of the late Medieval Period persisted, rather than disappearing only the re-emerge a few decades later (Lynch 1992).

Chapter 4. Identity, Religion, and Medieval Mortuary Context

Religious context of Medieval Asturias, Spain

Much of the following discussion deals with the social and religious context of the mortuary practices found throughout the Medieval period of Asturias, Spain and Western Europe in general. The understanding of this mortuary context is important as the investigation of mortuary treatment can provide a great deal of information regarding the cultural context in which the decedents lived (Charles 2005; Chapman 2005). Here the nature of this context is based on the interplay between religion (Christianity), formal social structure (in regard to the Christian Church), (in)formal social hierarchies (in regard to familial status) and familial bonds (emotional ties between loved ones), among other, more minor issues. The result in Medieval Asturias, Spain, is a complex arrangement of Christian graves organized into more or less formal cemeteries outside of churches, and collections of tombs inside churches.

In general the human skeletal remains analyzed for this project came from small rural Christian churches within the region of Asturias, Spain dating to the period between 900 - 1800 AD. Many of the skeletal remains were excavated from stone cist graves found either surrounding the church or within the church walls (for more details see Chapter 6). While the primary goal of this chapter is to discuss these mortuary contexts, first it is necessary to discuss the related issues of the Romanization of Iberia, the spread of Christianity, and the formal development of Christian cemeteries. The following narrative is primarily based on sources discussing developments within the Iberian Peninsula, but parallels drawn from similar religious practices or mortuary traditions in contemporary Medieval (Merovingian) France, Britain, and Eastern Europe are also brought to bear on the matter.

From Pagans to Christians

The Christianization of Western Europe often followed the cultural process of Romanization and both changes resulted in the replacement of many local traditions (Ferguson 2003). In fact the successful spread of Christianity benefitted from the expansion of Roman territory, the Romanization of indigenous cultures, and the eventual Roman adoption of Christianity. Most scholars agree that the Christianization of Iberia began to occur around the same time as the Visigothic invasions of the Iberian Peninsula, as Roman control of the region began to collapse (Carr 2005; Collins 2000; Heather 2006). During this period, the center of Spanish villages and towns shifted from administrative buildings to Christian churches; “as social life was ever more focused on the church, so people spent more time at or around the church, which is to say away from the forum and the great intramural buildings” (Kulikowski 2004:228). It would appear that this too occurred with moral authority and actual social power shifting from aristocrats to the clergy. This notion is supported by Kulikowski (2004) who comments that with this shift from administrative to religious authority: "the old Roman town plan had finally ceased to have any social significance (Kulikowski 2004:255)". Importantly these events set the stage for the abandonment of previous Roman codes such as those relating to the location of burials and cemeteries.

While the expansion of Roman territory occurred often through violent conflict (Curchin 1991), Romanization and the adoption of Christianity appear to have occurred via more of an adoptive, hegemonic process (Jenny 2011). Before the introduction of Christianity to Western Europe, most Europeans practiced the traditional form of Greco-Roman polytheism, now commonly referred to as *paganism,* which was often based on local traditions and beliefs (DiZerega 2004). These traditions were common in much of pre-Roman and early Roman Western Europe, and it is far more likely that pre-Roman Iberia and pre-Roman peoples in general, identified with their folk (pagan) traditions and ethnic backgrounds rather than a sense of larger political or religious embodiment (Woolf 1997; Woolf 1998; Braund 1998; Gillett 2006; Laurence 1998; Keay 1995; Williams 2005; Effros 2003).

The process of Romanization, that is to say, the adoption of Roman values and the often forced enculturation of indigenous peoples to Roman traditions that occurred during the expansion of the Roman Empire, is a much debated issue (Woolf 1998; Ruiz and Molinos 1998). For some scholars, such as Ruiz and Molinos (1998) the Romanization of Iberia occurred via the institution of the Roman villa system and the general introduction of Roman government into the pre-existing indigenous settlement patterns, which in turn brought about a slow loss of indigenous ethnic diversity. For Williams (2005) instead of a force of enculturation, Romanization was more a matter of acculturation as both indigenous and Roman values were constantly in flux and melding with one another.

Woolf (1998) on the other hand, argues Romanization was actually the result of a desire on the part of indigenous people to distinguish themselves in a new way. According to this theory, as indigenous peoples encountered Roman forces, they adopted specific Roman traditions in order to elevate their status with both Rome and their local bureaucracy. While this does not necessarily require a complete rejection of indigenous identity, it is clear that a system was established by which the more "Roman" a society was, the more they were perceived to be civilized.

In resolving this scholarly debate, one of the primary forms of evidence for studying the process of Romanization as well as the later process of Christianization can be found within changes in the mortuary practices of indigenous peoples. The resulting changes in mortuary customs brought about through Romanization may then demonstrate changes within the local society as a whole. On the other hand, Laurence (1998) cautions that identity and ethnicity are often fluid concepts. In death identities are created via mortuary treatment and what may be apparent through the mortuary record may only be how a person was to be remembered or their ethnicity as culturally dictated in a particular context. This means that homogeneous cemeteries may be the result of cultural phenomena due to particular contextual circumstances and changes to this mortuary treatment may reflect other cultural changes. Thus only through careful control of historical and archaeological context can the mortuary record be used to demonstrate meaningful symbolic treatment of the dead in respect to identity and ethnicity (see Goldstein 1981). Continuing a discussion of mortuary treatment and identity, Williams (2005) demonstrates that in Romanized areas, all individuals may have been buried in Roman fashion (typically cremation), however those not buried in the standard Roman form, or those with atypical artifacts may be indicative of alternative ethnic ideologies concerning death and the afterlife (e.g. Jews would not have been cremated).

As religion became a more important aspect of life during the late Roman and early Medieval periods, it would appear that ethnicity began to play a decreasing role in mortuary practices. Many scholars (e.g. Williams 1999; Rebillard 2003) now suggest that the ethnic determinants of mortuary treatment were affected by Roman traditions and then replaced by religious values. With the increasing power of organized religion and its replacement of many pagan traditions, the construction of organized patterns of mortuary customs based on these religious identities became more and more common (Williams 1999). Williams (1999) argues that after the widespread Roman adoption of Christianity following the Emperor Constantine's conversion to Christianity in the 4th century AD, burial likely no longer reflects ethnic identity or Romanism, so much as *religious* identity (although Christianity was heavily tied to Rome after its official adoption).

The development and spread of Christianity in Iberia

At the most basic level, Christianity began as a Roman urban cult which gained popularity and influence over time and eventually evolved into a complex and wide spread religious tradition (Carrol 2000; Kulikowski 2004). To Rebillard (2003), Christianity was extremely slow to develop and establish itself as a separate unique entity and Christians likely carried out mortuary practices alongside pagans and placed their internments with pagan burials for a long period. In reality, the dominant form of Christianity that emerged in the Medieval period is quite different than what was present throughout the Roman or Late Antique periods and the changes that are responsible for this unique construction have yet to be explored (Rebillard 2003:178). Likely many of these changes were due to the merging of Christianity with many local pagan traditions. This has led some to conclude that the identification of pagan or Christian burial elements is futile due to unique cultural contexts in which conversion took place (Geary 1994).Thus, just as in the case of Roman identity, a greater investigation of cultural or archaeological contexts within the mortuary record is required. These cemeteries must be recognized as being context specific and investigated as unique cultural constructs, not simply egalitarian, Christian individuals.

To Romans, intramural burial, that is, within the *pomerium*, or sacred boundary of the city which often coincides with its walls, was considered a form of pollution or contamination. Yet, beginning around 400 AD, shifts begin to occur in Christian burial. This is likely a function of the increasing authority of the Church as well as the general expansion of towns and the desire of townsfolk to pray and worship in the originally extramural churches which contained sacred Christian relics (Kulikowski 2004; Naji 2005). Kulikowski (2004) states that this change in mortuary practice is one of the greatest transformations Christianity brought to Roman society as it restructured how settlements were patterned and constructed.

Kulikowski (2004) suggests that the spread of rural Christianity in Spain did not begin until at least the 300s AD and made little progress until ~600-700 AD. Further, the sporadic continuation of paganism leads to questionable dates for when Christianity became adopted in the rural areas of Iberia (Kulikowski 2004). Much of rural Christianity appears to have spread as a function of wealthy landowners creating their own small churches where they followed a mixture of Christian and local folk (pagan) traditions. In addition, many of the churches located in these villas and large rural properties, were converted from other pre-existing structures for use by local villagers and farmhands (Kulikowski 2004). When comparing trends in Iberia to those found in Britain, Williams (1997) estimates that as many as 25% of medieval British cemeteries and burials occur in association with ruinous Roman or earlier structures. While this trend which is likely a function of symbolism and identity to past peoples, appears throughout Spain as well, the degree to which it occurred is unclear.

The isolated character of the Christian kingdoms in northern Iberia may have led to an extended period of pagan and Christian mixing. It is certainly the case that the northern Christian Iberians had little contact with Rome or the papacy until the ~1000 AD and historically this period is known for a great degree of heresy in the region (Jackson 1972). A particularly popular heresy was Priscillianism, an early medieval Spanish form of Christianity which seems to have accepted pagan practices and was quite common in rural areas (see Kulikowski 2004:243-249 for a full discussion). This heresy, which arose in the fourth century AD, is believed to be a derivation of Arian Christianity which was been practiced by the Visigoths until ~589 AD when King Reccared I converted to the Nicene orthodoxy (Bowes 2005).

The Medieval Christian Church in Spain

In general, religious scholars agree that churches were multi-functional buildings. Álvarez Fernándo et al. (2009) note, like many other areas of Western Europe, in Medieval Spain each village had a single church which served its religious community. In growing communities, these churches expanded or additional churches were built, as was often the case in larger cities (Conant 1978). However, the village church was more than just a place of worship. Since it was the largest building in the village, it was also a general meeting place and the location of most religious festivals that were held throughout the year. Álvarez Fernándo et al. (2009) add that a particularly important function of these rural Christian churches was to serve as one of the main geographical references for travelers and villagers alike. Furthermore, the church bell was used to mark the hours of the day or call villagers for meetings as well as for symbolic religious tasks (Álvarez Fernándo et al. 2009).

In addition to being a focal point of each village, the church served other economic functions as well. For instance, the church pastor collected the required taxes from the village community which was then passed along to the local administration. Also, each local family was obligated to pay a tithe to the church, which was usually 1/10th of their production, in order to be considered a true member of the community and enjoy the right to participate in the sacraments and be buried in the cemetery (Álvarez Fernándo et al. 2009).

Medieval Christian monasteries

Similar to rural Christian churches, Christian monasteries spread throughout Western Europe beginning in the third century AD. However, the height of popularity for monasteries in Christian Iberia was not until the twelfth century AD coinciding with the peak in Medieval pilgrimages (Grabow 2010). Monasteries themselves were actually a collection of buildings often including a church, barns, granaries, dormitories, and sometimes small hospitals. Geary (1994) notes, monasteries performed two functions in Medieval society. First, monastic clerics prayed for the well-being and salvation of the local population (typically for particular individuals), and secondly, these clerics performed ritual actions on behalf of the local population to keep the spiritual powers in good standing towards the locals (focusing more on the village as a whole). The idea was that the saints would bless the local population so long as the local population held them in veneration.

Because such an important responsibility for those living in monasteries was to pray for the salvation of other Christians, many wealthier individuals donated land, money, or jewelry in order to be especially remembered in monastic prayer. In Asturias, this resulted in monasteries becoming owners of large amounts of land and cattle. The vast majority of Asturian monks also came from towns and cities of Asturias. There were both male and female monasteries and it was typical for individuals to enter monastic life during childhood around the age of seven (Fernández et al. 2009). While all monks followed a rigid standard of living, each monastery was unique and these differences were expressed in ways that ranged from different religious practices to the color of the monks' robes.

In regard to cemeteries associated with monasteries, Ivison (1993:53) notes that theoretically the mortuary population of a monastic cemetery should be exclusive to a single gender with only one type of tomb typology, which was likely dictated by the monastic order. While Ivison is specifically referring to Eastern European traditions, these were likely similar in Medieval Western Europe including Spain. Ivison (1993) notes that in Byzantine Europe that monastic and common cemeteries may exist side by side and could easily be commingled with poor archaeological documentation; this mixing of the private monastic cemetery with the public village cemetery may have occurred in the case of the monastic project cemetery of San Salvador de Valdediós which includes members of both sexes.

The emergence of Christian church cemeteries

Christian burial practices and Christian cemeteries evolved throughout the Late Antique and Medieval periods. While Christianity continued to spread throughout Western Europe, much of the formal cemetery structure often associated with Christianity did not occur until later. The most common types of Roman internments were cremation burials in containers or, inhumation burials in sarcophagi for the wealthy, while the poor were usually interred without a coffin to avoid the expense (Toynbee 1971; Naji 2005). It is also the case that poor individuals were often buried without grave markers while wealthier individuals who could purchase markers would often create individual or family tombs which then served as public monuments to the dead (Carrol 2000).

Carrol (2000) notes that the word *cemetery*, from Greek meaning "sleeping place," was first used in 200 AD to refer to a Christian burial ground and it would appear that the Roman Christian Church established its first cemetery around the end of the 2nd century AD (Rebillard 2003). With the exception of the Italian catacombs, many early Christian cemeteries consist of cist graves oriented east-west with few or no grave goods with a single body interred likely wrapped in some kind of shroud or cloth (Williams 2007; Naji 2005). This is was a big change from previous pagan customs, many of which included grave goods or other unique local traditions. While there was a great deal of variation concerning the positioning of the actual body, typically the individual was placed lying flat on the back with the arms crossed at the chest, waist, or lying at the sides, and with the feet pointed towards the east, likely in expectation of the Last Day and Resurrection (Naji 2005).

Christians held that after death, the body separates from the soul but that these would again be united at the Resurrection. Therefore, mortuary preparations involved simply washing the body, clothing or wrapping it in a shroud, carrying it in procession and burying it in the village cemetery (Paxton 1990). It is believed that the underlying concept was that the Christian dead were only sleeping and would awaken at the End of Days to join the faithful in heaven (Carrol 2000). This is also likely why full internments were chosen over cremation (Carrol 2000). This likely relates to why early Christian burials consisted of piecemeal stone coffins (cists), that could easily fit the whole body in a flat position. These stone cist coffins were later replaced by wooden coffins, although there can be a great deal of variation related to status and wealth (Cantera 1987; Naji 2005). This too is different from many earlier practices such as urn or cremation burial. Paxton (1990) suggests that there was little need for any purification rituals because Christians in Medieval Western Europe believed that death was a rite of passage from this life to the afterlife.

One particularly important form of burial was that for Christians whose professions of faith had caused their death. Veneration for these early martyrs often resulted in specific mortuary treatment in regard to the emergence of early Christian cemeteries. Kulikowski (2004) argues that the esteem for these Christian martyrs and the desire of other Christians to be buried in close proximity to them may have been a precursor to future Christian mortuary practices. For example, Christians in the Spanish cities of Merida and Zaragoza began delineating portions of pre-established pagan cemeteries to bury their dead. It is no accident that these early Christian areas within pagan cemeteries were where Christian martyrs had been buried. Moreover, these locations rapidly became burial sites for the Christian wealthy and status-conscious elite (Kulikowski 2004:225). Kulikowski continues: "at most of Spain's early Christian churches, one can document the competition for interment as close as possible to the body or relics of the titular saint or martyr, a privilege soon guarded by the wealthiest and best-connected locals (Kulikowski 2004:255)."

However, other explanations have been offered for the growth of this practice. For instance, Effros (2002) suggests the shift in status displays from grave goods to grave location occurred due to high incidences of grave robbing, as implied by large fines for such acts noted in historical records. Bullough (1983) argues that early rural field cemeteries, typically considered of Christian origin, may actually have been created around 400-500 AD in response to the needs of Germanic immigrants. These Germanic field cemeteries may have then set the stage for later organized Christian row cemeteries after the groups began to interact and the mortuary practice.

All the same, at a basic, it became more important for Christians to be buried with other Christians, and by 900 AD, formal churchyards began to be established as the only acceptable place for Christian burials. In exploring this process, Zadoro-Rio (2003) notes that while many early Christian burials were structured, these were not truly organized or formal Church sanctioned and controlled cemeteries. In fact, it would appear that until the eighth century AD, the clergy were not concerned with the burial treatment of common Christians (Effros 1997:11). Gradually though, the clergy became the spiritual intermediaries between the living and God in reference to funerals and the commemoration of the dead. It is at this time that that bodies began to be buried at the church cemetery according to hierarchies of wealth, status, and spiritual devotion and that this apex of this structure was characterized by close proximity to the saintly remains contained within the church (McLaughlin 1994; Effros 1997; Naji 2005). Bullough (1983) adds that by around the end of the eleventh century, most inhabitants of Western Europe could expect to be laid to rest in the graveyard of the village church where they had been baptized and had attended mass in their lifetime (Bullough 1983:181).

As the Christian Church tightened its grip on what practices were allowed for both the living and the dead, local or regional differences in thought, potentially tied to specific beliefs of ethnic identity resulted in different burial patterns. As Geary (1994:44) notes, "the study of religion in the early Middle Ages must be grounded in the actions of early Medieval societies rather than in the inherited and poorly assimilated belief tradition of doctors of the Church." Thus, church texts can be misleading as these doctrines were not always followed. This would help to explain how, after the spread of Christianity, deviant burial practices often persisted until the point that the Christian Church gained control over formal burial and fully supplanted all aberrant behavior (Williams 2005; Rebillard 2003).

Medieval Christian mortuary treatment

With the spread of Christianity and the establishment of formal Christian cemeteries throughout Western Europe came the concept of *ad sanctos* burial. *Ad sanctos* burial, which roughly translates to “in the presence of saints,” refers to the Medieval Christian practice of mortuary status being reflected by burial in proximity to saintly remains or Christian relics (Naji 2005). Scholars suggest that this practice arose from the belief that these relics would help protect the fate of the soul on Judgment Day (Naji 2005; Geary 1994). This was a widely practiced mortuary custom throughout much of Medieval Western Europe including France and Spain. Álvarez Fernándo et al. (2009) among others, argue that *ad sanctos* burial most often resulted in wealthy or high status individuals being buried within the church walls (typically under the church floor) while the poor received burial in the cemetery outside the church (James 1989). Kulikowski (2004:236) notes that this *ad sanctos* ideology appears to have been in place in some urban areas of Spain as early as the fourth century AD and McLaughlin (1994) adds that burial in proximity to churches in general was important as churches served as the spiritual focal point of the community.

Beginning first with the veneration of martyrs and then evolving into the worship of saints, the bodies of saints, or objects that had been in close contact with them, this "cult of relics" offered a way for the living to interact with the divine (Geary1994:168). Likewise, *ad sanctos* burial became a central focus of religious devotion in Western Medieval Europe (Geary

1994:166). McLaughlin (1994:25) suggests that much of Medieval Christian burial patterns (including *ad sanctos* burial) reflect the vertical relationships between individuals and God and horizontal relationships between the local Christian community. Using historical documents, Bango Toviso (1992) argues that in early Christian Spain (before the 900s AD) there was a hierarchy of burial location that depended upon strength of religious conviction. Non-Christians were buried outside the church (meaning beyond the formal grounds of the church), faithful Christians in general would receive burial in the open area before a church, and the higher status faithful were buried near the walkway or entrance of the church. Interestingly, the desired location for *extra-ecclesia* Christian burials was often in proximity to the church portico. The belief was that these individuals would be the first of the burials outside the church to enter the door to paradise (Bango Toviso 1992). While burials found within the floors or foundations of a church are typically thought to be those of local saints, wealthy individuals were often able to use these spaces as well (Bango Toviso 1992). Unfortunately, in Spain the clergy did not maintain the same type of records which were kept in Medieval France which makes a study of the burial of individuals according to their social class more difficult (Bango Toviso 1992). Similarly, Ivison (1993) demonstrates that Christian burial locations varied both within churches and within common church cemeteries according to status or social relationships, in the Byzantine world as well.

In the end, it would appear that the practice of burying individuals close to saints and other prominent members of society began to develop into a hierarchical system of its own. For example, in Merovingian France, kings began building churches specifically to be buried inside them (James 1989:29). Additionally, James (1989) notes that in Medieval France, proximity of poor graves to prestigious graves may be indicative of individuals attempting to be associated with other (non-saintly) elites (referred to as: *ad potentiores* "in the presence of the powerful"). If, as Geary (1994) argues, relics and saintly remains were important enough to generate their own system of commerce, it should then be reasonable to conclude that this Medieval system of burial *ad sanctos,* in reference to these sacred remains may have also developed its own commercial system where the wealthy could simply purchase their elite burial location.

Interestingly, the accessibility of intra-church burials began to increase by the 1200s AD and was widespread by the 1500s AD, despite the Church's initial attempts to regulate this type of burial (Bango Toviso 1992). This appears to be the result of the Church agreeing to bury many individuals intramurally who were considered to have a higher status (e.g. members of the clergy, local wealthy individuals, “honored men”, men who lived good or saintly lives) (Bango Toviso 1992). The large number of “intra-ecclesia” burials in San Pedro de Plecín may be a reflection of this trend, for many individuals were granted burials with the walls of this church. At the same time, Bango Toviso (1992) points to historical records that indicate that burial at the altar was reserved only for “holy fathers” such as the bishops, abbots, and priests. Additionally, any member of the community who sponsored the construction of a monastery or gave a public endowment to support the community was typically granted any burial space they wanted (Bango Toviso 1992). Bango Toviso (1992) further comments that as more and more individuals were being buried within the church, the most prestigious location became the chancel (eastern area of a church near the altar), focusing on the apse. Due to these increases in intra-ecclesia burial, in the 1500s AD, Church law dictated that graves were not to come above the level of the church floor because many of these intramural burials were becoming an impediment to the faithful church going Christians (Bango Toviso 1992).

In addition to social status and *ad sanctos* burial, there are other reasons why particular individuals may have been buried within or outside a church's walls. Burial within a church protected the monument and inscriptions from destruction over time from weather and erosion from the elements (Beaver 1998). Additionally, burial within a church allowed a greater sense of memory and distinction from those undifferentiated individuals or families in the common church cemeteries (Beaver 1998). Further, Beaver (1998:100) argues that in Medieval Britain, males were more likely to be buried within churches, as well as yeoman farmers over husbandmen. Beaver (1998:100) also suggests that within church burials may reflect proprietary rights, such as the proprietor of the rectory being buried intra-ecclesia, or simply the proximity of loved ones already buried within a church. While Beaver argues that "burial inside the church constituted an important political distinction in status and authority from burial in the churchyard (1998:99-100)", he continues that: "yet status (meaning burials within churches) often seems to have been accorded to particular families for reasons now obscure (Beaver 1998:100)".

The evolution of religious traditions is common and while Paxton (1990) demonstrated that originally the physical body of Christians was important for the Resurrection, associated with the increase in the practice of *ad sanctos* burial, Naji (2005) suggests it appears that the eventual fate of the physical body lost its importance. In earlier Christian ideology, a great deal of emphasis was placed on proper burial and preservation of the body, because of the link with resurrection; this is likely the reason inhumation was officially chosen over cremation during the 300s AD (Naji 2005). However, Naji (2005) argues that with the adoption of *ad sanctos* burial, this concern seems to have dissipated, likely because sacred burial space was limited and began to be treated as a commodity. Because of this issue of limited space, throughout this period the reuse of graves became common, often including the layering of individuals within a single grave. This means that the relative positions of individuals within a single grave may suggest meaningful familial or other cultural relationships. Moreover, Naji (2005) notes that the insertion of infant burials and the disturbance of older remains were commonplace and often these now disturbed older skeletonized remains would then be gathered in a new location on church grounds such as an ossuary or charnel house (Breton 1867). While church records are lacking in Spain, many Medieval church cemeteries from Asturias, Spain contain ossuaries, which are likely examples of these practices (for instance: San Pedro de Plecín and San Pedro de Nora).

Chapter 5. Research Expectations

Introduction

The proposed study uses standard bioarchaeological methods to evaluate health and paleodemographic trends in the region of Asturias located in northern Medieval Spain. By examining skeletal indicators of demography and physiological stress, this dissertation attempts to provide insight into the association between pathological insults and mortality as well as examine life histories of the general rural population of Medieval Asturias at the regional level. This project examines these factors by aggregating all individuals from all available sites, and directing scientific inquiry at regularities at the regional scale. Working from what contextual information is available from the historical record, it is reasonable to conclude that these small sites should reflect the general indigenous peasant population of Asturias, Spain as a political region and unit over time.

Such an approach is possible because these sites share numerous characteristics. They are all small rural communities with a single Christian church (excluding the Catedral de Oviedo and San Juan as these sites both occur in Oviedo, the largest city in Asturias) contained within the historic and political boundary of Asturias, Spain. Further, immigration to these areas was limited historically because these sites represent small rural agricultural villages in a relatively isolated region in northern Spain, thus they likely reflect closely related biological populations. For example, Fernández et al. (2009) note that individuals were usually married at sixteen to eighteen years of age to partners from their own village or one nearby.

The following research expectations were developed from the histories of Medieval Spain and Medieval Asturias. Using a Historical Bioarchaeology approach, these research expectations will be examined using the bioarchaeological record to inform the historical record. Skeletal markers of stress and disease were scored using the criteria described in Chapter Seven. The skeletal collections utilized for this project were chosen due to their geographic and temporal significance relative to the historical narrative of Asturias, their accessibility, and their lack of previous systematic study.

The current project investigates three research expectations. These research focuses on these expectations which are based predominantly on previous historical and bioarchaeological work surrounding the Medieval Asturian population. These expectations are important and based on previous research by a number of scholars. However, the greater importance of these expectations may lie in the exploration of these issues themselves within the context of Medieval Asturias, Spain. For example, with a lack of previous study, it is unclear if we should really expect females in Asturias to be less healthy than their male counterparts. While historians often suggest this trend for Medieval Spanish contexts, it is not typically found in the Spanish bioarchaeological record. This investigation then will not only test hypotheses based on the available historical narrative, but also set the groundwork for future context specific studies of Medieval Asturias, Spain. These research expectations will first be introduced, then explained in greater detail.

Research Expectation 1: Diachronic Change

I expect the frequency of stress markers to increase across villages for the region of Asturias from Phase I early (~900-1300 AD) to Phase I late (~1300-1500 AD) during Spain's centuries of crisis and to continue this increase into Phase II (1500-1800 AD). In addition, I expect markers of infectious disease to increase during the Spanish Empire (Phase II) due to increases in population density and consequent disease transmission.

Research Expectation 2: Inferred Gender Inequality

I expect there to be no differences in the proportions of adult males and females, nor significant differences between sexes for markers of skeletal health or mortality in either Phase I or Phase II.

Research Expectation 3: Inferred Antemortem Status Inequality

I expect skeletal markers of stress and disease (LEH, tibial periostitis, cribra orbitalia, porotic hyperostosis, and other bony infections) to have lesser prevalence in individuals buried within church walls than those individuals buried outside church walls. Further, those individuals buried outside church walls should have significantly shorter adult statures related to reduced access to resources during development, and there should be a greater relative amount of subadult burials outside the churches as these limited resources may have resulted in increased frailty.

*Research Expectation #1***:** Diachronic Change

Because the biological health of a society is associated with its economy (see Steckel 2004) and because many historians specializing in the Medieval period suggest that the economic conditions of Medieval Spain were less than adequate to sustain a population devoid of negative health markers (Martz 1983; Lynch 1991; Ruiz 2007), I therefore expect markers of non-specific stress to appear more frequently during periods of economic downturn and crisis. Further, because markers of stress are often associated with increased frailty and reduced resistance to infectious disease (Rose et al. 1978), I also expect skeletal markers of infectious disease to increase during these periods of economic crisis. Specifically, I expect the frequency of stress markers to increase across villages for the region of Asturias from Phase I early (~900-1300 AD) to Phase I late (~1300-1500 AD) during Spain's Centuries of Crisis and to continue this increase into Phase II (1500-1800 AD). In addition, I expect markers of infectious disease to increase during the Spanish Empire (Phase II) due to increases in population density and consequent enhanced disease transmission.

Spain's centuries of crisis (~1300-1500 AD, Phase I late) occurred after the Muslim controlled territory of Iberia (excluding Granada) was reconquered by the Spanish Christian kingdoms (Mackay 1977). Ruiz (2007) argues that a stagnation of military affairs combined with civil wars, the Hundred Years war, and outbreaks of the bubonic plague led to economic crisis throughout Christian Iberia. This economic crisis was further exacerbated by climatic changes leading to shorter, wetter summers and colder winters resulting in poor(er) crop yields and widespread famine (Ruiz 2007). Although the general population of Asturias may not have been directly affected by most of these political events, rural peasants generated almost all of their income through agriculture (most of Spain was a subsistence economy during this period; Martz 1983). Previous to Ruiz (2007), Lynch (1991) demonstrated that these subsistence crises due to poor harvests and low yields were frequent after 1300 AD, producing malnutrition and reduced resistance to infectious disease. Further, Martz (1983) argues that when considering the potential cost of famine compared to the plague, years of plague outbreaks do not appear to show dramatic drops in baptisms, whereas years of famine do. Thus I expect significant increases in the prevalence of developmental stress markers (LEHs, cribra orbitalia, porotic hyperostosis) in Phase I late compared to Phase I early due to these subsistence crises.

The rise and construction of empires often leads to increased stress and disease on the subject populations, as evidenced in the newly discovered Americas (see Tung 2003). In both the imperial population as well as the subject populations, general nutritional stress may decrease due to increasing economic benefits (better trade routes, job specializations, diversity in diet), this is also accompanied by increases in population density which can result in problems with sanitation, water accessibility, and increased infectious disease and parasite transmission all leading to additional strain on the community (Tung 2003; Andrushko 2007; Walker et al. 2009). Some have suggested that the discovery of the New World brought an end to Spain's economic crisis, but they fail to take into account the ways in which increasing economic benefits can actually cause stress for a population. While some historians argue the economic (and subsistence) crisis was only averted by the discovery of the New World and the associated influx of revenue from gold and silver imports as well as economic investments by other nations (Ruiz 2007; Kamen 2005; Elliott 1989), others note that it is unclear how the construction of empires and increasing globalization may affect the dominant imperial populations in their home territories (Elliott 1989:10).

Lynch (1992) suggests that although Spain's economy began to thrive with the establishment of the Spanish Empire (after 1500 AD), this was short lived as the economy quickly deteriorated and Spanish subsistence crises began (again) in the early 1600s. Similar to the previous Spanish crisis, peasants were hard pressed to pay all their debt and still be able to sustain themselves, which Lynch (1991) argues was mostly the result of inefficient farming techniques. The common method was biennial rotation using a three-field system which resulted in declining crop yields. At the same time, rents were now continuously raised as prices for grain increased with inflation (Lynch 1991). Lynch states: "[the] evidence suggests that charity was not enough and could not prevent a steady deterioration of the health and living conditions of the poor (Lynch 1991:151)". Therefore I expect to see the overall health of these rural peasants to continue to decline during Phase II.

On the other hand, populations of Galicia and Asturias are said to have expanded during this period (Kamen 2005:244; Lynch 1992:8), but to what extent is unclear. This may reflect an increase in subadult survivability (while experiencing developmental stress) due to the self sufficient nature of these rural agricultural family units. Should demographic trends in subadult mortality remain constant or improve, this would suggest a lack of negative changes in access to resources (i.e. net nutrition via adult stature). This could be explained by parents having more offspring than before (increased fertility/fecundity), where these children are then experiencing developmental stress because resources are spread too thin, but with greater overall subadult survivability because they are still able to eventually attain the resources they need and experience catch-up growth (Cardoso and Garcia 2009).

Because of this I expect significant increases in the prevalence of developmental stress markers (LEHs, cribra orbitalia, porotic hyperostosis) in Phase II compared to Phase I late. I also expect significant increases in markers of infectious disease and pathogen load (tibial periostitis and other bony infections) after the year 1500 AD as increases in population densities were accompanied by reduced resistance to disease due to limited nutritional resources. Combined with the expectation of health markers to deteriorate from Phase I early to Phase I late, this should demonstrate a trend of decreasing health over time.

If the Spanish economic crisis was as severe and persistent as some scholars argue (e.g. Lynch, Ruiz, and Martz), then I expect the frequency of stress markers to increase across all villages for the region of Asturias from Phase I early (~900-1300 AD) to Phase I late (~1300-1500 AD) during Spain's centuries of crisis and for these increases to continue into Phase II (1500-1800 AD). In addition, if the Spanish Empire period does correspond to increases in population density and consequent disease transmission, then I expect markers of infectious disease to increase during Phase II.

Research Expectation #2: Inferred Gender Inequality

I expect there should be no differences in the proportions of adult males and females, nor should there be significant differences between sexes for markers of skeletal health or mortality in either Phase I or Phase II.

Cohen and Bennett (1993) argue that skeletal data can be used to approach questions of gender and gender inequalities in past societies through a number of different variables. Here, societal gender roles are examined via biological sex (males, females), via physiological stress markers (LEH, tibial periostitis, cribra orbitalia, porotic hyperostosis, and other bony infections), and mortality distributions. Scholars often suggest patriarchal Medieval societies had sex biased access to resources and healthcare, which this expectation directly investigates using the available scholarly framework (Gies and Gies 1978; Bennett 2005; Lopez et al. 2012; Miller 2003). However, the greater purpose of this expectation may be to explore if the patriarchal nature of Medieval Spain had a significant bias effect on the health of individuals living in Medieval Asturias. The intent is not to directly and independently test the previous work of historical scholars, but to examine the trends found by other scholars within the context of Medieval Asturias, Spain. Historical scholars suggest the societies of Medieval Western Europe were patriarchal (Gies and Gies 1978; Bennett 2005), and that females were marginalized in these patriarchal societies (Lopez et al. 2012; Miller 2003). Because the marginalization of individuals often results in health disparities (Dodgson and Struthers 2005; Lopez et al. 2012), I expect female individuals from Medieval Asturias to display greater frequencies of non-specific stress markers and infectious disease.

Medieval Spanish society, like most societies in Medieval Western Europe was patriarchal. This patriarchal nature restricted the ability of women to interact outside of their domestic and reproductive duties, essentially banning them from most political, legal, religious, and economic decisions (Gies and Gies 1978; Bennett 2005). Women were not allowed to hold political positions or carry out other civic responsibilities. Most were restricted from owning property or establishing contractual agreements. They were unable to hold positions of religious office or importance, and could not perform many jobs or tasks which were considered to be for men (Gies and Gies 1978; Bennett 2005). Particularly in Spain, girls (with a few exclusions) were not permitted to attend school until after the beginning of the 1800s, and the Church publicly denounced female literacy and education throughout the Medieval and Spanish Empire periods (Lopez et al. 2012; Miller 2003).

A recent study by Lopez et al. (2012) attempted to investigate the degree of potential gender discrimination in northern Spain using cemetery samples from multiple regions in northern Spain outside of Asturias. The presence of dental caries and the degree of antemortem tooth loss were examined by Lopez et al. (2012) as indicators of dental health from seven Medieval (11^{th} -15^{th} centuries) and "Modern" (15^{th} -18^{th} centuries) cemetery samples. Their study found no significant differences between the sexes for dental caries or antemortem tooth loss in the Medieval Period. However, significant differences between sexes were found in the Spanish Empire Period, with females having a greater frequency of dental caries, and males having a greater amount of antemortem tooth loss at older ages in the Modern period (Lopez et al. 2012).

Dental caries are often associated with an increased consumption of carbohydrates and other cariogenic foods and commonly used to investigate dental health in bioarchaeological populations (Larsen 1997; Lopez et al. 2012; Kerr 1998; Vodanović et al. 2005). Interestingly, higher frequencies of carious lesions in males is typically reported throughout Medieval Europe and other patriarchal societies, and associated with sex-biased access to nutritional resources (Šlaus 2011; Vodanović et al. 2005). The contradictory findings of Lopez et al. (2012), suggest that the greater amount of dental caries for females in northern Spain is actually the result of gender-biased access to dental healthcare (rather than nutritional resources). This is because much of the dental healthcare in Medieval Europe revolved around tooth extraction and thus, the increase of carious teeth in females and the increase antemortem tooth loss in males may actually be the result of a differentially sex-biased accessibility to dental care (Lopez et al. 2012; Anderson 2004; del Valle and Romero 2006; Suddick and Harris 1990).

However, while women were unable to achieve the same level of status as men and were restricted in their social roles, this gender bias was likely minimally reflected in small rural villages (Fernández et al. 2009). In these family units, typically both boys and girls were expected to assist with housework as soon as they were capable (Nicholas 1995) and while a division of labor between sexes occurred, this does not appear to be associated with increased frailty (Lopez et al. 2012). It should be noted that access to dental care may not have been dependant on location, as the Lopez et al. (2012) samples did include four rural sites. However, in a similar study investigating skeletal health from another cemetery from northern Spain outside of Asturias, Galera (1989) found no differences in the frequency of adult males and females and no significant sex differences for non-specific stress markers in a similar Medieval Spanish sample (dental health was not similarly investigated at in the Lopez et al. study).

While some historians argue that males were more frequent in the population demographic during the Medieval period due to social practices such as female infanticide and exogamy (Dickerman 1979), closer inspection of these data actually suggest relatively similar sex frequencies (Siegfried 1986; also see Stuard 1984 for discussion). In addition, Russel (1948) demonstrates that urban centers and frontier areas typically draw more males than females. However, unlike large urban centers which were often affected by immigration of poor peasants and foreigners in search of work, emigration of wealthy males to the New World, or the loss of males for war against the Moors during this period, these Asturian sites are small rural villages far from any direct conflict or political center. Further, while the pilgrimage of Santiago de Compostela runs through Asturias and thus potentially attracted male pilgrims in a higher frequency than females (Webb 1999), or increased commercial speculation by foreigners (also typically males), these church sites are not found along the route (excluding the Catedral de Oviedo which is located in the most urban city in Asturias).

Finally, there is no evidence that suggests any temporal shifts in gender roles during either phase of this period, other than the findings relating to access to dental healthcare of Lopez et al. (2012). If rural Medieval Asturian society was not significantly patriarchal and if there were no significant migratory pressures affecting the region, then I expect there to be no significant differences in the total numbers of adult males and females, nor should there be significant differences between sexes for markers of skeletal health or mortality in either Phase I or Phase II.

Research Expectation #3: Inferred Antemortem Status Inequality

Bango Toviso (1992) suggests that Medieval mortuary status in Spain is reflected in *ad sanctos* burial. If skeletal markers of stress and disease serve as a proxy for indicators of social status, and if *ad sanctos* burial reflects social status in Medieval Asturian mortuary treatment, then I expect that individuals found outside the church walls will display greater prevalence of skeletal markers of stress and disease (LEH, tibial periostitis, cribra orbitalia, porotic hyperostosis, and other bony infections). Further, those individuals buried outside church walls will display significantly shorter adult statures (statistically) related to decreased access to resources during development, and there should be a greater relative frequency of subadult burials outside the churches as these limited resources may have resulted in increased frailty. This is due to the fact that those individuals or families with greater income/status should have been able to afford the more prestigious burial locations inside churches, whereas the poorer peasants would not have had access to the prestigious burial locations.

Goldstein (1981:57) states: "Because mortuary practices are a reflection of inter-personal and inter- and intragroup relations, as well as a reflection of the organization of a society as a whole, examination of the spatial components can yield information on at least two broad levels: (1) the degree of structure and spatial segregation and ordering of the disposal area itself may reflect organizational principals of the society as a whole; and (2) the spatial relationship to each other of the individuals within a disposal area can represent status differentiation, family groups, descent groups, or special classes, dependent upon correlation of these spatial relationships with other dimensions of study."

Ad sanctos burial, then, is an excellent example of how mortuary practices may be used to examine status differentiation and family groups in a disposal area. *Ad sanctos* burial was a widely practiced mortuary tradition in Medieval Christian Spain (and throughout Medieval Western Europe; Bango Toviso 1992; Naji 2005), and thus social status may be inferred from burial location at these churches. Privileged individuals (typically those wealthy enough to afford it) were buried "*intra-ecclesia*" (i.e. within the church walls) whereas the commoners were buried "*extra-ecclesia*" (i.e. outside the church walls; Bango Toviso 1992; Naji 2005). Further, *ad sanctos* burials will contain multiple individuals, most likely representing family groups, and therefore equal numbers of female and male adults should be present. Other distinctions were made between those privileged "*intra-ecclesia*" burials where individuals buried closer to the church doors or apse for example, may have had greater or different levels of social prestige (Bango Toviso 1992; Ivison 1993; Effros 1997). Due to limited contextual evidence, here the relative burial status for individuals within the church is referred to as "high", while those individuals buried *extra-ecclesia* is listed as "general".

Concerning this project, individuals are considered high status in relation to the other members of their society who were not buried within the church under the assumption that if a family had the disposable income to acquire a prestigious burial location within a church, then the family also likely had enough income to take care of their nutritional needs. Thus I expect those individuals buried within Asturian church walls will be healthier than those contemporary individuals buried outside church walls. If this hypothesis is correct, those buried within the church will exhibit a significantly lesser prevalence of non-specific stress markers (LEH, tibial periostitis, cribra orbitalia, porotic hyperostosis, and other bony infections). Moreover, I expect to see significant discrepancies in average adult stature for individuals buried in cemeteries outside the church compared to those individuals within the church walls. Finally, because childhood mortality may be reduced in families that had more disposable income and could afford *ad sanctos* burial, I also expect to find a greater number of subadults compared to adults buried outside the church walls. Children buried within the church walls would not simply be wards of the church because during the medieval period children who were orphaned at churches were often transferred to monasteries or nunneries, or adopted by local families with established households (married couples that had the means to care for children) rather than being sheltered and raised by the small local church which already relied on tithing to sustain the local clergy (Siegfried 1986).

If medieval mortuary status is reflected in *ad sanctos* burial, then I expect skeletal markers of stress and disease (LEH, tibial periostitis, cribra orbitalia, porotic hyperostosis, and other bony infections) should have lesser prevalence in individuals buried within church walls than those individuals buried outside church walls. In addition, if *ad sanctos* burial reflects wealthier families, then I expect to find adults with shorter statures outside the church walls (due to reduce access to net-nutrition) as well as a greater number of subadults compared to adults (due to increase frailty) because those families with less income/access to resources would not be buried in prestigious locations. The reasoning behind the level of analysis for within church versus outside church for this project is because the archaeological context of many of these excavations is not presently available. Thus while reports mention if individuals were excavated within or outside the church walls, the finer details of spatial distributions are often missing (see Chapter 6 for further information).

Summary

These research expectations are investigated using a dynamic research scheme of analysis at the regional level. Direct hypothesis testing methods along with other more exploratory methods are employed in order to generate a more complete understanding of lifeways in Medieval Asturias, Spain. Finally, this project will contribute greater knowledge to the history and bioarchaeology of Medieval Spain in several key aspects:

(1) There have been only a few very minor reports regarding the skeletal remains from Asturias or any other sites in northern Spain (Camino Mayor 2003; Consejería de Cultura y Turismo 1992, 1995, 1999; Fernández Reyero and García de Castro Valdés 2009; Villa Vlades et al. 2008; du Souich et al. 1990 and references therein) all of which tend to have only superficial results at a synthetic level; whereas this project will directly attempt to answer anthropological questions with these data and thus put the skeletal biology into historical context.

(2) This is the first regional approach to the skeletal biology of Asturias (or any other Medieval Spanish region).

(3) This analysis of skeletal health will allow for a greater understanding of temporal change throughout the region of Asturias, specifically from the economic issues related to the birth and expansion of the Spanish Christian kingdoms to the Golden Age of the Spanish Empire, and allow for other future comparisons of Medieval time and change to human biology.

(4) This analysis will investigate how historical notions of sex-biased discrimination and differential access to nutritional resources may result in differential expressions of stress and mortality in Asturian females and males.

(5) This analysis will directly investigate social issues regarding familial status and wealth via *ad sanctos* mortuary treatment.

(6) This analysis will be one of the first to investigate the potential changes found in an empire's home territory as a result of Imperialism. These investigations will be accomplished by evaluating historical observations utilizing biological data, all of which relate to generating knowledge of regional population life-histories.

Chapter 6. Materials

Introduction

This research will use multiple skeletal collections recovered from rural Medieval church cemeteries located in Asturias, Spain dating throughout the Medieval period (~900-1800 AD) (Table 1, Figure 1). Because these cemeteries are derived from small rural populations in a region known for poorly preserved skeletal remains, reaching levels of statistical significance is hindered at a site level of analysis. This project attempts to resolve these issues by approaching anthropological questions at a regional level, aggregating all the project sites.

A general two-phase chronology will be used to help cluster and simplify sites by time period. Note, the cemeteries of San Juan and San Pedro de Plecín* both occur in different project phases, however individuals are able to be temporally segregated and are thus presented independently.

The site descriptions are presented below alphabetically by phase.

Table 1. Asturian site: names, locations, approximate MNI, phases, and dates

Site	~ MNI	Status	Map ID	Dates of Use (AD)
Phase I				
Phase I Early				
Iglesia de Santa María de Villanueva	7	High	D	1000-1100
San Juan	13	Common	L	1100-1200
San Pedro de Nora	26	Common	G	1100-1500
San Miguel de Liño	22	Common	F	Likely 1100-1400
San Salvador De Cornellana	6	Common	I	1100-1300
San Salvador De Valdediós	28	Common	J	900-1300
Phase I Late				
Casco Histórico de Villaviciosa Rehabbilitación	17	Common	B	1300-1500s
Ermita de San Lorenzo de Cortina	5	Common	C	1250-1400s
Iglesia de Santo Tomás de Riello	12	High	E	1300-1600s
San Pedro de Plecín	36	High	H	1200-1800s*
Phase II				
Catedral de Oviedo	9	High	K	1600-1800
San Juan	34	High	L	1500-1700
San Julian De Viñon	82	Common	M	1400-1800
San Julian De Viñon	2	High	M	1400-1800
San Pedro de Plecín	25	High	H	1200-1800s*

Figure 1. Locations of sites in Asturias, Spain. Light Blue = *Phase I early*, Dark Blue = *Phase I Late*, Green = *Phase II*. Note some site markers overlap and are therefore not visible. For interpretation of the references to color in this and all other figures, the reader is referred to the electronic version of this dissertation.

Phase I Early Sites:

Santa María de Villanueva

The remains associated with the church of Santa María de Villanueva, located in Teverga, were excavated in 2001 and date to approximately 1000-1400 AD (Beneitez Gonzalez and Villa Vlades 2003). The remains were recovered from within the church walls. Sondeo 1 ("survey 1") uncovered six burials near the church apse, while sondeo 2 uncovered a small ossuary and sondeo 3 uncovered an un-described number of skeletal remains (Beneitez Gonzalez and Villa Vlades 2003). Only remains from sondeo 1 were available for study and included in this project. Much of the necropolis which was located outside of the church appears to have been destroyed during remodeling and reconstruction from 1700-1900 AD.

San Pedro de Nora

The cemetery associated with the church of San Pedro de Nora, located in Las Regueras, was excavated in 1991 dating to approximately 1200-1600 AD*. Different typology of burials present in the cemetery allows for the discrimination between multiple phases of internments. Phase I consists of medieval cist burials dating approximately between XII-XV, Phase II consists of later pit burials, Phases III and IV are later medieval or poor early modern graves found outside the church, and finally Phase V consists of modern brick graves (Martinez Faedo 1995:289-290). Also present is an ossuary which likely dates between Phases I and II. Unfortunately, documentation for the excavations is unavailable, making correlation of burial phase to most of the remains impossible. However, the modern graves appear to have been transferred to another location for reburial, thus only medieval remains should be present in this study (Martinez Faedo 1995:290; also see Adán Alvarez 1997).

San Salvador De Cornellana

The cemetery associated with the monastery of San Salvador De Cornellana, located in Salas, dates to the "Romanic Phase" consisting of flat graves dating between the 1100-1300 AD (Martinez Villa 1992:253). The site itself has undergone multiple excavations, however the burials analyzed were recovered in 1989.

San Salvador de Valdediós

The remains from the cemetery associated with the Romanesque Convent of San Salvador de Valdediós located in Villaviciosa, were excavated in 1985 and date to approximately 900-1800 AD*. (Fernandez Conde and Alonso Alonso 1992). The tombs represent (at least) three phases. Phase 1: Pit burials (dating to the late medieval period) which all have similar orientation (though the actual orientation is not described), evidence of shrouds, and with some having evidence of ceramics (see Figure 2 in Fernandez Conde and Alonso Alonso 1992). Phase 2: not clearly defined and only represented by one burial dating between 1200-1500 AD. Phase 3: dating ~900-1200 AD, consisting of cist tombs of various styles (see Figure 3 in Fernandez Conde and Alonso Alonso 1992). These mixed grave typologies appear to be associated with the reuse of tombs as well as the highest density of graves in the necropolis. In addition, there are marine shells (mollusks), as well as the evidence of small fires over some of the grave stone slabs, which appears to be related to funerary rituals (Fernandez Conde and Alonso Alonso 1992). *Only burials from Phase 3 were available for study and included in this project.

San Miguel de Liño (also referred to as: "San Miguel de Lillo")

The remains from the cemetery associated with the Romanesque church of San Miguel de Liño, located in Monte Naranco, were excavated in 1989 and date to approximately 1100-1400 AD. Unfortunately, very little information is available regarding the necropolis, however, the burials consist of typical medieval cist graves (Hauschild 1992; Garcia de Castro Valdes 1995). Other pit burials have been excavated more recently, however these were not available for study (Requejo Pagés et al. 2009).

Phase I Late Sites:

Casco Histórico de Villaviciosa Rehabbilitación

The cemetery associated with the site labeled "Casco Histórico de Villaviciosa Rehabbilitación" actually reflects the cemetery of the church Santa María de la Oliva, located in Villaviciosa, excavated in 2002, and dating from approximately 1250-1400 AD. The necropolis consists of a "very dense sequence of occupation, signified by the partial or total destruction of tombs and the consequent formation of small deposited ossuaries among the graves. (Fernandez 2003:396)" The only documented internment typology is the simple Christian grave (body deposited East-

West into a wooden box (coffin) as documented by the presence of nails), the earliest grave is carbon dated between 1264-1400 AD with a 95.4% probability (Fernandez 2003:396). Full recovery of the cemetery was apparently hampered by a high water-table and continuous intrusion of water into the excavations (Fernandez 2003:396).

Ermita San Lorenzo de Cortina

The cemetery associated with the chapel of San Lorenzo de Cortina, located in Llaranes was excavated in 2002, dating to approximately 1250-1400s AD. The semi-excavated medieval necropolis (consisting of seven burials) is located outside the church walls however it was only partially recovered as much of it is covered by a modern road. Later excavations (not included here) have recovered additional burials from within the church (Ríos González 2010). Excavations of the interior of the chapel have yet to be undertaken. This is reportedly the first medieval necropolis to be carbon dated in Asturias, with the earliest burial dating to ~1250 and the latest dating to 1400s (see: http://www.parroquiadellaranes.org/San%20Lorenzo.htm).

Santo Tomás de Riello

The cemetery associated with the church of Santo Tomás de Riello, located in Teverga, was excavated in 1998 and dates to approximately 1300-1600 AD. The excavated graves consist of six overlapping pit burials recovered from the foundation of the sacristy: “all of them have similar features such as east-west orientation, being parallel to the church, and the remains being in supine positions. Below the six burials were three slab tombs (cists) made with slabs of slate, two being east-west oriented (Adán Alvarez 1999:286)."

San Pedro De Plecín

The cemetery associated with the church of San Pedro de Plecín (originally named "San Salvador", but this changed ~1400-1500 AD) is located in Alles and was excavated in 1991, dating from approximately 900-1800 AD*. From the cemetery, 48 interments were excavated from within the church, composed of three general burial phases: (Plecín-Phase 1, dated ~XIII-XIV) slab-burials (cists) made of limestone, with bodies in supine position with the legs straight; (Plecín-Phase 2, dated ~XV-XVI) pit burials located within the church walls, with bodies oriented East-West, in supine position with the limbs in different positions, the first excavated ossuary is likely associated with these burials based its' on stratigraphic level (Project Phase I Late), and (Plecín-Phase 3, dated ~XV-XIX -Project Phase II) the most recent graves, almost always superimposed on the older graves with no uniformity to burial direction or body position containing two excavated ossuaries, this phase also contains an unexcavated ossuary attached to the Chapel. These phase dates are mostly based on relative stratigraphy and the dating of coins found in association with the burials. While contextual evidence of these excavations is generally lacking, the phase of each internment is available (see Adán Alvarez 1995) and thus this different burials from this cemetery will be used for different aggregated site phases in Asturias. Adán Alvarez suggests that some of the tombs within the church came from individuals whose families were financing the church's construction and maintenance (Adán Alvarez 1995:315).

Phase II Sites:

Catedral de Oviedo

The remains associated with the cathedral de Oviedo, located in Oviedo, were excavated between 1998-1999 and date to approximately 1600-1800 AD. The remains were recovered from three separate sarcophagi (S1, S2, S3) (from within the cathedral), all from within the "cripta oriental". S1 contained multiple individuals and García de Castro Valdés notes that at least some of the associated lower limb elements were still in anatomical position. The sarcophagus is described as being constructed from very fine grained white limestone called "Piedramuelle Laspra" likely from quarries are near Oviedo (García de Castro Valdés 2000:39). S2 contains a single individual in supine position, in a sarcophagus of Yellow limestone from outcrops of Monte Naranco (García de Castro Valdés 2000:41). S3 contained at least 2 adult individuals the primary internmente being more complete and in supine position; the sarcophagus was constructed from the same limestone as S1. It appears that S1 and S2 were both disturbed at some point by thieves as human bones were found scattered from the sarcophagi (García de Castro Valdés 2000:42). García de Castro Valdés suggests that these individuals were likely aristocratic clerical of Oviedo (García de Castro Valdés 2000:44).

San Juan (also referred to as: Antiguo Colegio San Isidoro)

This site was excavated in 2000 and dates to approximately 1100-1875 AD (García de Castro Valdés 2002). During excavations two different cemeteries were uncovered, (1) early medieval and another, (2) late medieval (Spanish Empire). In addition, two slab tombs were located within the early medieval temple (T-10, T-11) near the alter, and represent early medieval burials (~1100 AD) (García de Castro Valdés 2002:103). The (1) early medieval cemetery consists of 12 burials in organized rows, further there is no overlap or disturbances of tombs, suggesting the cemetery was well planned (a similar cemetery was excavated in the Jardin de Pachu at the Catedral de Oviedo; not included in this project). Only the remains from one of these tombs was available for study (T-16, not included in this project) and the archaeologist notes that most of these tombs contained no obvious bones from poor preservation and skeletal diagenesis (García de Castro Valdés 2002:104).

Specifically, Tombs 21 and 26-31 date to the Low Medieval period, likely around 1100 to 1200 AD. These represent clay graves outside the temple, in the area close to the altar (N-side of the temple) and were likely typical peasant individuals. T-16 was not included in the report, likely as a typographical error and it is assumed that T-16 should be included with tombs 15-20. Tombs 1 and 2 were recovered from the interior of the Romanic building dating to the 1500 to 1700s. Based on the location these were most likely high rank church officials. Tombs: 4, 5, 6, 12, 15, 17-20, 32, 34-40 were recovered inside the Romanesque temple (rooms 4-6) dating to the 1600-1700s. These individuals were likely higher status peasants or lower-ranked priests. The Phase II remains from the cemetery are associated with the Romanesque church of San Juan (Bautista) and come from the church's final phase of occupation when it was intended to accommodate the facilities of the Jesuit college of San Isidoro, located in Oviedo.

San Julian de Viñon

The remains from the cemetery associated with the Romanesque church of San Julian de Viñon, located in Cabranes, were excavated in 2005 and date to approximately 1400-1800 AD. The majority of the graves represent late medieval slab burials oriented East-West or associated ossuaries; however two burials (Ent. 1 & Ent. 2) were recovered from within the apse of the church and likely represent higher status individuals possibly dating to the pre-Romanesque foundation of the church. This project is in the process of being completed and a majority of this work is still being analyzed (Personal communication Rosario Suarez Vega 2010, publication pending).

Project approach to Mortuary Archaeology

“Because mortuary practices are a reflection of inter-personal and inter- and intragroup relations, as well as a reflection of the organization of a society as a whole, examination of the spatial components can yield information on at least two broad levels. First, the degree of structure and spatial segregation and ordering of the disposal area itself may reflect organizational principals of the society as a whole. Second, the spatial relationship of the individuals within a disposal area can represent status differentiation, family groups, descent groups, or special classes, dependent upon correlation of these spatial relationships with other dimensions of study (Goldstein 1981:57)”.

In taking a bioarchaeological approach to this project, there are some major theoretical issues one must confront aside from those directly related to archaeological documentation and context and skeletal preservation. Here these inherent problems arise via the study of mortuary archaeology due to the large amount of regional variation present in Christianity throughout

Western Europe and the differential practice and adherence to written Church doctrine that persists in the historical record. For instance, Geary (1994:30) states that historians and archaeologists alike "face major conceptual and methodological problems as they attempt to reconstruct Medieval religious culture." This potential bias may then occur as small rural churches may or may not follow standard protocol or exhibit characteristics one may expect to find based on other, nearby urban localities.

Fortunately, the amount of variation present in the burial record of the sites included in this research sample appears to be minimal. Individuals were typically buried in stone lined cist tombs, which often suggest signs of reuse due to the inclusion of multiple internments. In addition, multiple project churches include burials within the church walls and/or outside the church walls. Further, multiple sites have ossuaries present from the reuse and disinterment of previous individuals buried in the church's cemetery. All these factors are likely related to the adherence of *ad sanctos* burial in some form in this region. Unfortunately any documentation directly related to mortuary patterns is currently unavailable.

While all church cemeteries known in Asturias exhibit typical Christian characteristics, it is possible that Jewish individuals are present but lack artifacts to discriminate between the faiths. Further, Asturias is unique in that it is one of only two regions in Iberia (the other being the Basque Country) which was never occupied by the Moors, thus lacking a real Muslim presence and Muslim burials. However, Islamic burials may be readily identifiable as they do not typically use coffins and the burials are oriented with the body to face towards Mecca (Insoll 2001).

This project attempts to use this framework to approach issues of cultural identity and status via the mortuary record from multiple rural Christian church cemeteries. This research is primarily concerned with the general distribution or clustering of graves around Medieval Christian churches located in Asturias, Spain. Specifically due to the fact that *ad sanctos* burial was likely practiced in Asturias throughout the duration of the project sites and that the practice of *ad sanctos* burial is a reflection of Medieval mortuary status (Bango Toviso 1992). Investigations in regard to mortuary location and biological health (as a proxy for cultural status and wealth) will be conducted in order to examine the correlations of *ad sanctos* burial and burial status (see Chapter 5 for additional information).

Chapter 7. Methods

General Data Collection Procedures

The laboratory methods used here for human remains were standard to those employed in bioarchaeology consisting of macroscopic metric and non-metric data collection. Metric data was obtained using calipers accurate to .1 mm and an osteometric board accurate to 1 mm. All standard measurements (Buikstra and Ubelaker 1997, Ousley and Jantz 2005) were collected on all available skeletal elements and a few additional measurements were also taken when possible (Berrizbeitia 1989; Semeraro and Passalacqua 2007).

Minimum Number of Individuals

The minimum number of individuals (MNI) was determined by frequency of repeated elements per grave by sex and age. Thus the assumption was that each internment represents isolated individuals from all other graves (e.g. the remains of one individual are not located in multiple graves). While the reuse of graves was practiced at this time, if individuals were removed from their original burial location, they were likely placed in collective ossuaries, not other graves (at least in theory). Unfortunately due to varying degrees of preservation and extensive commingling in ossuaries, the MNI estimates from these are extremely problematic. Individuals were only included from ossuaries when some elements can be reasonably paired or distinguished from other burials by size or taphonomic characteristics.

Age-at-Death Estimation

The age-at-death of each individual was estimated using a range of available indicators. Mean (point) age estimates, age ranges, and age classes were generated for each individual (Buikstra and Ubelaker 1997). These age estimates were sample dependent, as all individuals included in this project were seriated amongst each other in an aggregate sample. This allowed for age-at-death estimates to be more precise and more accurate as well as more homogeneous within each sample allowing for more accurate comparisons of health between site-specific samples. Uhl and Passalacqua (2009) previously demonstrated that seriation of individuals generates age distributions which more closely reflect the actual age-at-death distribution of the population than generating multiple single age estimates independently for each individual.

Sex Determination

Sex was determined for all adult individuals (those with fused epiphyses) using latent class analysis (LCA) in M*plus* (see below). Because M*plus* is able to generate probability statements with incomplete data present, adult sex was determined for any individual with at least one measurement available for the latent class model. All 64 measurements, both cranial and post-cranial, were utilized in the LCA for sex determination (see appendix 2).

Adult Stature Estimation

The estimation of adult stature is crucial for demographic assessment as well as the stress of malnutrition and disease on biological development. Adult stature (while genetically controlled) is determined by environmental variables such as diet and disease (Malcolm 1974; Goodman et al. 1984; Kemkes-Grottenthaler 2005), and has been linked to overall standard of living (Komlos and Baur 2004). Physical stressors may result in shorted adult stature as (1) the individual receives too few nutritional resources to fuel the growth process, (2) the body must divert those nutritional resources to the costly demands of fighting illness, (3) demands placed on the body through physical work may also draw nutritional resources away, or any combination of those factors (Andrushko 2007; Lambert 1993).

Adult stature was estimated using any available long bone measurement with preference to the femur when present. Accurate stature estimates were made using Fordisc 3.0 for "all groups" in order to include a large amount of known human variation into the estimate, and thus achieved the most accurate stature estimate possible. However, due to the lack of knowledge regarding the genetic potential of the populations for stature, and the genetic homogeneity of these populations over time, these estimates are subject to both nutritional and genetic biases. Stature estimates generated from these data will be compared to other stature estimates obtained from previous publications in order to evaluate health in terms of net nutrition and potential secular change (Steckel 2004; Steckel 2005; Bosch et al. 2009).

Non-specific stress markers

Non-specific stress markers are pathologic changes to dental or bony tissues associated with disease and/or malnutrition. However, these changes are result from a number of different conditions, thus being dubbed: “non-specific” (Ortner 2003). Here non-specific stress markers such as: linear enamel hypoplasia (LEH), dental caries, cribra orbitalia, porotic hyperostosis, tibial periostitis, and other general infections were scored using the criteria of Steckel and Rose (2002). This system allows for a great deal of data to be collected quickly and simply and for comparisons to the GHHP. Further it allows for easy compensation of shifts in samples sizes using frequencies of presence/absence of boney regions and reactions.

In addition, other variables such as the presence and severity of degenerative joint disease (DJD) and skeletal trauma were also scored using the criteria of Steckel et al (2005). However while these criteria are included because they are necessary for the use of the Health Index in order to generate a relative ranked comparison of health and nutrition to other Western European sites (see below), they will not be evaluated independently as part of this project.

Linear enamel hypoplasia

Linear enamel hypoplasia (LEH) are small depressed linear bands in teeth (deciduous and permanent) which result from growth disturbances that disrupt the normal formation of dental enamel (Ortner 2003; Hillson 2002). "Abnormal tooth formation is generally a nonspecific phenomenon and can be related to a variety of local and systemic disturbances (Kreshover 1960)." Because these disruptions occur during enamel formation (amelogenesis), they actually reflect childhood stresses although they are often found in the permanent dentition of adult individuals. Typically LEH result from malnutrition (e.g. weanling diarrhea) or diseases which physically stress the developing body (Goodman and Rose 1991; Hillson 2002). LEH have been found to occur in association with tuberculosis and rickets (Ortner 2003). The development of

LEH may be linked with weanling stress, however there is no consistent correlation (Perry 2005). Here, only linear defects observed on the anterior dentition, incisors and canines, were scored, as these are the teeth most often affected by hypoplastic disruptions (Steckel et al. 2002; Lukacs 1992).

Hypoplasias were examined visually and recorded by presence and quantity per tooth crown. The standard for documenting hypoplasias followed the Walker method described in the Global History of Health Project Codebook (Steckel et al. 2005:15): “a hypoplasia is present only if the indentation can be felt with your fingernail.” Only defects observed on the incisors and canines were scored, as these are the teeth most often affected by hypoplasias (Steckel et al. 2005:15). Following the Global History of Health Project Codebook, only linear defects were documented, excluding pit type lesions.

0. Not observable (no suitable teeth, incomplete development, or too worn, etc.)
1. No hypoplasia present
2. One hypoplasia present
3. Two or more hypoplasia present

Porotic hyperostosis

Porotic hyperostosis (cribra cranii) is a pathological porosity of the posterior cranium, most often occurring in the ectocranial surface of the parietals (Ortner 2003; Stuart-Macadam 1987). Porotic hyperostosis occurs from marrow hypertrophy due to the need for increased red blood cell (RBC) production. This increase in RBC production causes expansion of the diploë, thinning of the cortical layers, and cranial porosities (Ortner 2003). Porotic hyperostosis is typically caused by a deficiency in RBCs, hemoglobin, or total blood volume (Andrushko 2007:110). While previously associated with Iron Deficiency Anemia (IDA), recent work by Walker et al. (2009) demonstrated that IDA does not result in porotic hyperostosis/cribra orbitalia as previously hypothesized. This is because iron is required for erythropoiesis, which is responsible for marrow hypertrophy. The anemic response for marrow hypertrophy is then likely caused by factors related to megaloblastic (or hemolytic) anemias (Walker et al. 2009, Andrushko 2007). Megaloblastic anemias tend to result from the insufficient absorption of nutrients often resulting from bacterial or parasitic infections, and unsanitary living conditions, all of which are related to vitamin deficiencies; particularly forms of vitamin B which are needed to produce hemoglobin (Andrushko 2007). Subadults are often said to develop porotic hyperostosis or cribra orbitalia (see below) as a result of weanling diarrhea, however actually demonstrating this in archaeological materials is difficult (Perry 2005).

Porotic hyperostosis was scored using a modified version of Steckel et al. (2002), Buikstra and Ubelaker (1994), and Milligan (2010), and bony reaction was scored using the criteria of Milligan (2010). Here the presence of woven bone will suggest an active reaction at the time of death, as this is the first type of reactive bone to be deposited. Sclerotic bone suggests an inactive or healed lesion, where the deposited woven bone has had time to be remodeled. The presence of both woven and sclerotic bone suggests an ongoing, chronic infection. This system for scoring lesion activity was used for all the following stress markers.

Severity:

0. Not observable

1. At least one partial parietal present with no observed porosity

2. Porosity only present on at least one parietal

3. Coalescing pores with vault expansion present on at least one parietal

Activity:

1. Active (woven) at the time of death

2. Healed (sclerotic)

3. Mixed active and healed present

Cribra orbitalia

Similar to porotic hyperostosis, cribra orbitalia is a pathological porosity affecting the roofs of the eye orbits (specifically, the orbital plate of the frontal bone). However, unlike porotic hyperostosis, cribra orbitalia appears to be more often associated with inflammation of the periosteum covering the orbital plate, or the orbital plate itself (osteitis) than anemic responses (Wapler et al. 2004, Walker et al. 2009). As such, cribra orbitalia is considered an indicator of malnutrition and vitamin deficiencies, and appears to be strongly linked to vitamin C deficiency. Deficiencies in vitamin C are responsible for the weakening of Sharpey's fibers which attach the periosteum to the orbital roof, thus minor trauma can then easily cause sub-periosteal bleeding resulting in cribra orbitalia (e.g. scurvy) (Ortner 2003; Andrushko 2007).

Cribra orbitalia was scored using a modified version of Steckel et al. (2002), Buikstra and Ubelaker (1994), and Milligan (2010) as shown here:

Severity:

0. Not observable

1. At least one orbit present with no observed porosity

2. A cluster of mostly fine foramina covering a small area, present on at least one orbit

3. Coalescing pores with orbital roof thickening present on at least one orbit

Activity:

1. Active (woven) at the time of death

2. Healed (sclerotic)

3. Mixed active and healed present

Periostitis

Periostitis (or osteoperiostitis) is the pathological deposition of new bone on the outer cortex of bones resulting from inflammation/irritation of the periosteum (Goodman et al. 1988). Unlike osteomyelitis, periostitis is found only on the outer cortex of the bone. Deposition of new bone on the outer cortex occurs first as vascularized woven bone which then may be remodeled into lamellar bone and incorporated into the underlying cortex (Ortner 2003:206). However, if there is pathological communication between the medullary cavity and the outer lesions, this should be considered osteomyelitis (Brian Spatola personal communication).

Periostitis is often the result of traumatic injury and/or the presence of infection via *Staphylococcus/Streptococcus* bacteria (Larsen 1997:83). While the linking periostitis directly to infection is not always clear, Steckel et al. (2002) argue that the prevalence of periostitis often increases in situations of unsanitary hygienic conditions and dense population aggregation, thus associating the condition with increasing urbanism and disease. Periostitis is most commonly found on the tibiae, the cause of which is unknown however, it may be due to cooler temperatures from thinner layers of overlying soft tissue (Ortner 2003: 209).

Tibial periostitis was scored using a modified version of Steckel et al. (2002) and Buikstra and Ubelaker (1994), as shown here:

Severity:

0. No tibia(e) present for scoring
1. No infectious lesions of the tibia(e) present with at least one tibia available for observation
2. "Slight" Small discrete patch(s) of periosteal reaction involving less than one quarter of the tibia(e) surface on one or both tibiae
3. "Moderate" Periosteal reaction involving less than one-half of the tibia(e) surface on one or both tibiae
4. "Severe" Periosteal reaction involving more than one-half of the tibia(e) surface (osteomyelitis is scored here).

Activity:

1. Active (woven) at the time of death
2. Healed (sclerotic)
3. Mixed active and healed present

Other infections

This category actually encompasses non-tibial periostitis as well as specific stress markers and/or disease states such as: syphilis, tuberculosis, rickets, and other pathological states. Other infections were scored using the following criteria adopted from Steckel et al. (2002).

Severity:

0. No periosteal reaction on any other bone than the tibiae
1. Periosteal reaction on any other bone(s) than the tibiae
2. Evidence of systemic infection involving any of the bones (including the tibiae) of the skeleton.

Activity:

1. Active (woven) at the time of death
2. Healed (sclerotic)
3. Mixed active and healed present

Statistical Analyses

The statistical procedures for this project were carried out using M*plus*, which is a statistical package designed to use mixture models (Muthen and Muthen 2010). Mixture models are probabilistic models for representing the presence of sub-populations within an overall population, here latent classes. M*plus* is also designed to deal with latent or hidden variables and to handle missing data. The main idea behind the programming is the use of (iterative) Frequentist statistics, by running all procedures via a full information maximum likelihood method. Maximum likelihood estimation (MLE, a Frequentist approach) is a method for estimating the parameters of a statistical model by selecting values for the model parameters that produce a distribution that gives the observed data the greatest probability (Sokal and Rohlf 1995:769). Additionally, MLE is adept at dealing with missing data due to the iterative approach of borrowing information from similar cases and applying it to the missing case datum (whereby full model parameters are estimated from existing sample variables). Typically missing data is considered missing-at-random (MAR), and thus other informative values are used in order to generate posterior probability statements (Little and Rubin 2002, see below for further discussion).

Sex was estimated using M*plus* for all adult individuals. Here sex was treated as a latent variable, meaning other variables inform our predictions of sex, and the variable itself is unknown (Konigsberg and Frankenberg 2007; Kramer and Konigsberg 1999). The variables used to predict sex were the most common skeletal measurements present, excluding long bone length, since these measurements were used to estimate stature (Figure 1). Because we know the latent variable sex, has two classes, male and female, the estimation of class membership here, is rather simple and based mostly on size.

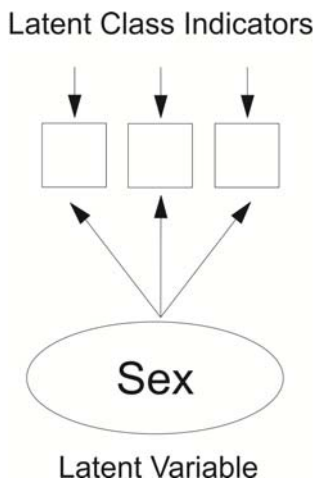

Figure 2. Diagram demonstrating LCA for sex estimates. Here metric measurements were used as latent class indicators (see Results for further details).

Ideally, sex would be estimated as part of the full hypothesis testing model, however due to the large time scale the project sites encompass (~900 years), there is a significant amount of secular change found between sites in each phase. Individuals in Phase II are then expected on average, to be taller and larger than individuals from Phase I sites. Due to this potential bias, Sex was estimated for each phase independently and these classifications were then be used in the later Hypothesis Testing statistical Model (HTM).

The HTM simultaneously performs logistic and least square regressions on all dependant variables (biological sex, age-at-death, site status, site phase) to all independent variables (LEH, cribra orbitalia, porotic hyperostosis, tibial infections, other pathologies, and adult stature) (Figure 2). In order to evaluate the prevalence of pathologies between dependant variables both ordinal linear regression and least squares regression will be employed for ordinal (rank-order) and continuous data, respectively. Logistic regression analysis was chosen instead of chi-squared analysis, or the use of odd ratios, due to the ability of logistic regression to rapidly determine the significance and strength of the associations between the dependant and independent variables within the present mixture model.

The idea behind latent variables is that the co-variation between observed variables is due to their relationship with a latent (unobserved) variable. The latent variable (or variables) then explains this relationship between the observed variables (McCutcheon 1987:5-6). Similar to cluster analysis, latent class analysis (LCA) attempts to classify cases into undefined groups of cases from a sample using observed variables. However, LCA uses conditional probabilities to measure the distances between the new groups (classes), unlike cluster analysis which uses scaled distance measures to explain the separation between groups such as Euclidean or Mahalanobis (Baxter 1994). Further, LCA can be used as an exploratory or hypothesis testing method, whereas cluster analysis is considered more of an exploratory method (McCutcheon 1987; Baxter 1994). LCA assumes a parametric model (similar to factor analysis), and thus uses the observed variables to estimate parameter values for the model (McCutcheon 1987). The LCA model uses the number of specified latent classes and then generates conditional posterior probability statements (the probability of latent class membership) of each latent class, for each case in the sample (McCutcheon 1987).

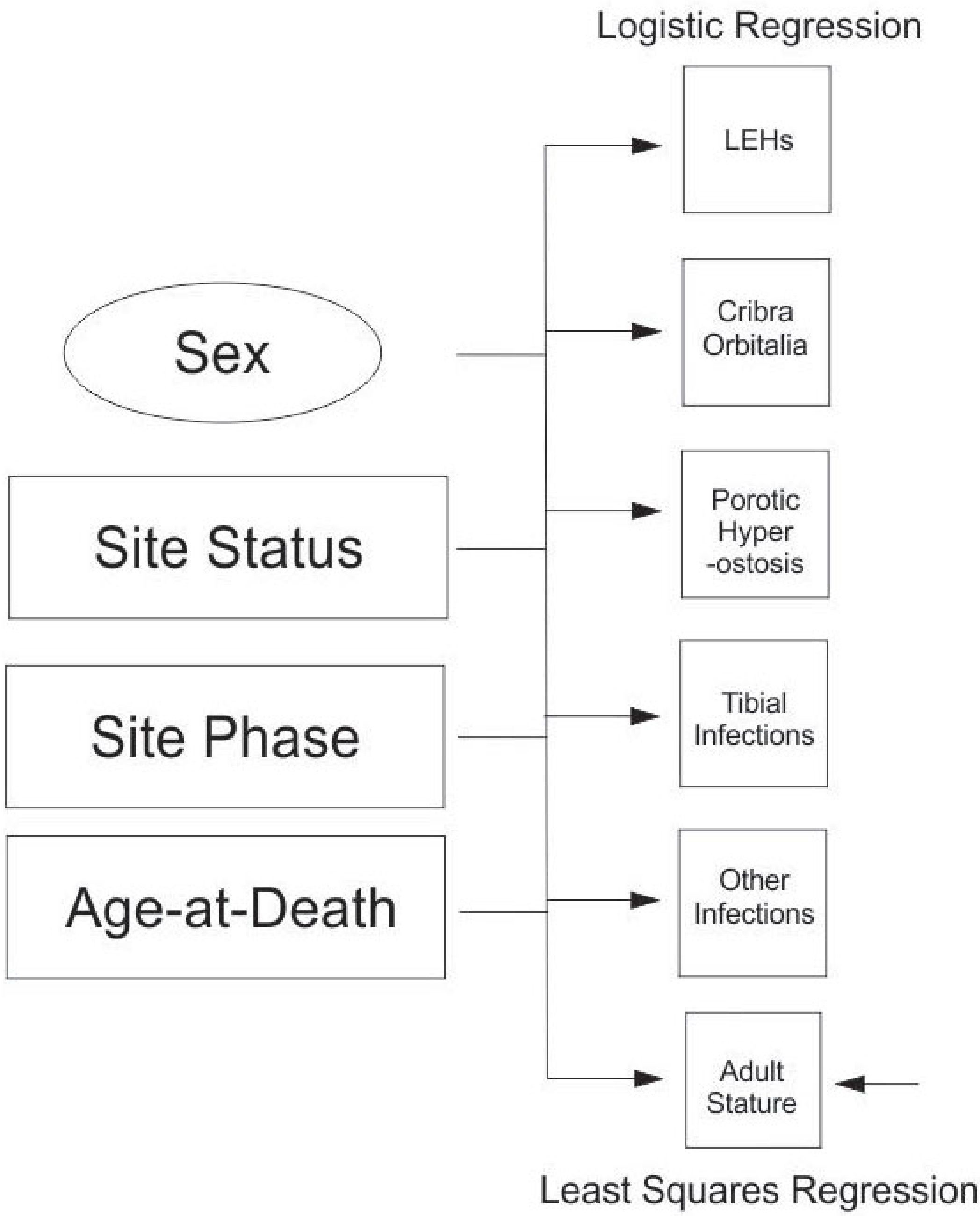

Figure 3. Diagram of M*plus* statistical model.

An additional benefit of using M*plus* is that it is designed to easily handle missing data through Frequentist analysis (Muthen and Muthen 2010:8). Missing data is a constant problem in bioarchaeology due to preservation and recovery issues which often result in incomplete sets of remains or cemetery samples (Waldron 2007). However, our statistical goals should be exactly the same when we have missing data as when we have no missing data (Raykov personal communication 2010). Thus, instead of having to rely on using listwise deletion and further decreasing sample sizes, M*plus* allows for the assumption that the data is MAR and can generate sample statistics using a full information maximum likelihood method.

In addition to the direct HTM, latent class analysis (a form of cluster analysis) was again utilized, to discover any potential associations of dependant variables (e.g. time, sex, status) not already explicit. This latent class procedure will be referred to as the Exploratory Model (EM). By using latent class analysis in this way, this EM allowed for an examination of groups of dependant variables based on independent variables which are more similar to each other than to any other possible groups. This procedure also allowed for additional conclusions to be drawn as to which variables appear to co-occur, and/or to lend additional support to the conclusions from the HTM.

Non-Complex Statistical Testing

Aside from the M*plus* statistical modeling, two-tailed T-tests and Chi-Squared tests were employed to test for significant differences between groups for continuous and non-continuous data respectively. In addition, age structure and mortality were examined using age distributions by time period and/or inferred status. Significant differences in age distributions were examined using the industry standard approach of the two-sample Kolmogorov-Smirnov test (i.e. Grauer 1991). In addition, subadult/adult (SA) ratios (a variation on the juvenile/adult ratio used to examine fertility; see Pietrusewsky and Douglas 2002) were used to broadly investigate relative mortality rates. Calculated as: SA Ratio = n subadults/n adults X 100.

Health Index

Finally, relative rank-order Health Index scores were generated for each: site, sex (males, females), site phase, site status, and age class; using the criteria of Steckel and Rose (2002). The health index (HI) developed by Steckel et al. (2002), ranks aggregations of individuals clustered into sites, time periods, etc., in order to understand relative rankings in biological “health”. Here, health is measured by 37 dental and skeletal variables including: age-at-death and stature, as well as presence and severity of dental and bony pathologies (LEH, dental abscesses, dental caries, antemortem tooth loss, cribra orbitalia, porotic hyperostosis, tibial periostitis, other skeletal infections, and auditory exostoses), degenerative joint disease and skeletal trauma scored on different regions of the skeleton (See Steckel et al. 2002 for further details). Unfortunately, the algorithm for this calculation is not available and the HI can only be used by uploading data into a website (http://global.sbs.ohio-state.edu/healthIndex) which then generates an output based on the input data. To further complicate matters, the output data generated has no guidelines for interpretation or discussion of how the HI scores were actually calculated. As the data transformations are left as a mystery to the observer, there is limited ability to discuss why sites may rank as they do which must then be reflected in the discussion of any results involving the HI.

HI scores were generated by phase, inferred status, phase and inferred status, and for each project site using the criteria of Steckel and Rose (2002). These HI scores served as general relative measures of overall health between all three time periods as well as other Iberian and Western European Medieval sites (Steckel et al. 2009). While recent research has cast doubt on the ability of the HI to actually represent biological health (Passalacqua et al. 2011), these results are still presented for comparison to other projects.

Chapter 8. Results

Hypothesis I

The first hypothesis examined issues related to change over time, stipulating increases in the frequency of stress markers across villages for the region of Asturias, Spain from Phase I early to Phase I late during Spain's centuries of crisis and continuing into Phase II. An additional expectation was for the frequencies of markers of infectious disease to increase during Phase II. In order to examine potential changes over time, several statistical procedures were used.

The full hypothesis testing model (the inclusion of all variables in a single analysis), was unable to be run due to insufficient sample sizes from the lack of variable co-occurrence. Instead, logistic regressions were performed for LEH, cribra orbitalia, tibial periostitis, and other skeletal infections (see figure 2 in Methods Chapter) in M*plus* (Muthen and Muthen 2010). Since M*plus* was used for the logistic regressions, all analyses were performed under maximum likelihood estimation, the only real difference is that each independent pathological variable (e.g. cribra orbitalia) was run as an independent analysis with all other variables present in the analysis in order to serve as potentially informative markers. Porotic hyperostosis was excluded from all statistical procedures as there was no occurrence of this pathological cranial porosity in any of the available project individuals (n= 0/141). Similarly, variables relating to the severity of stress markers were not evaluated as the presence of variables was not significant. Frequencies of all variables by phase are presented in Table 1 and Figures 1-5.

Table 2. Frequencies of skeletal markers of stress and disease present by phase

Skeletal Marker	Phase I Early	Phase I Late	Phase II
LEH Present	0 %	18 %	14 %
Cribra Orbitalia Present	14 %	29 %	14 %
Porotic Hyperostosis Present	0 %	0 %	0 %
Tibial Periostitis Present	0 %	0 %	5 %
Other Skeletal Infections Present (n)	0	2	8

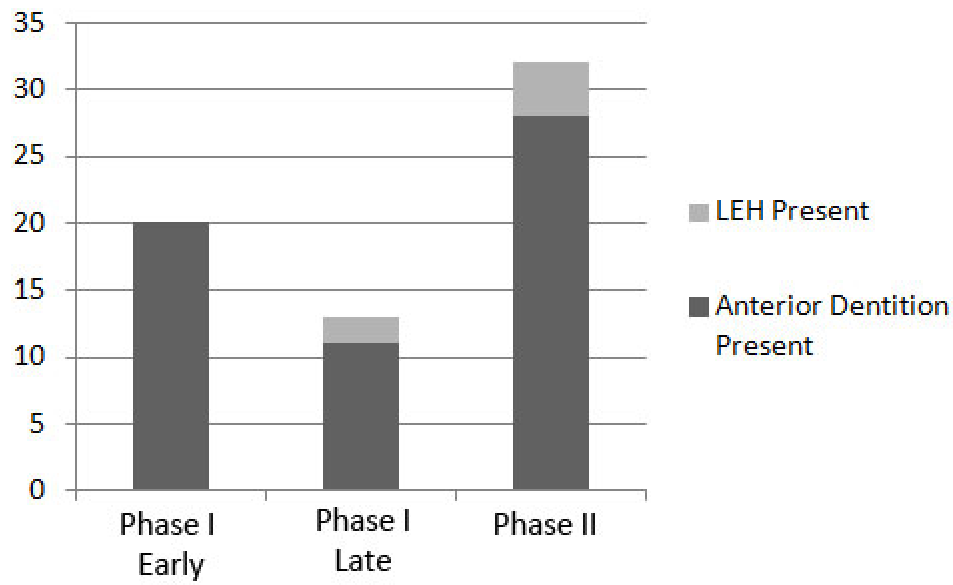

Figure 4. Frequency of anterior dentition and linear enamel hypoplasia present in project sample by phase.

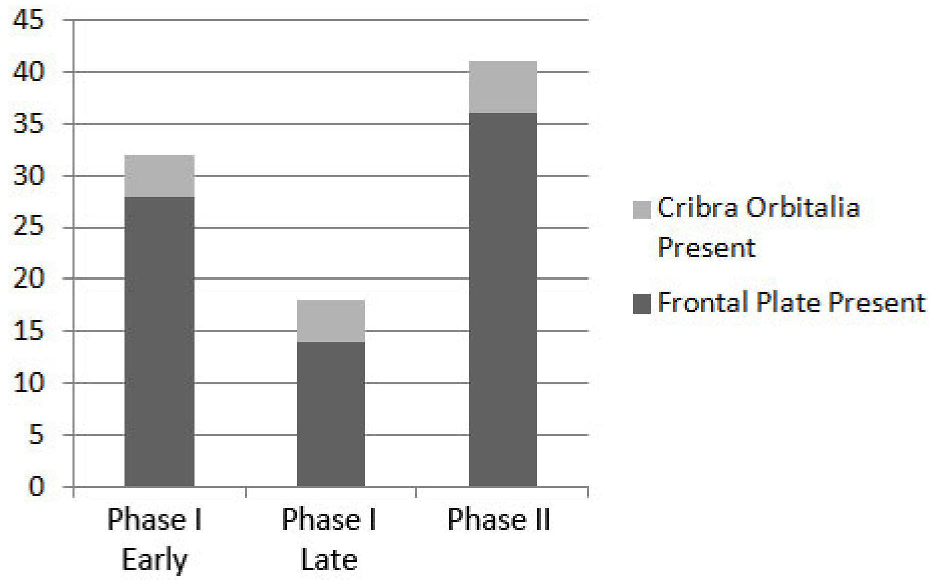

Figure 5. Frequency of frontal plate and cribra orbitalia present in project sample by phase.

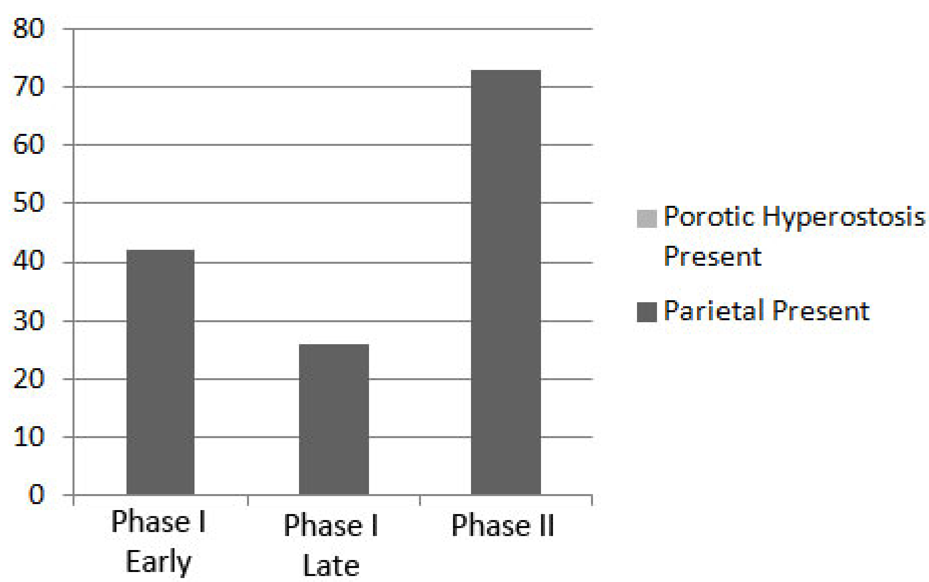

Figure 6. Frequency of parietal bone and porotic hyperostosis present in project sample by phase.

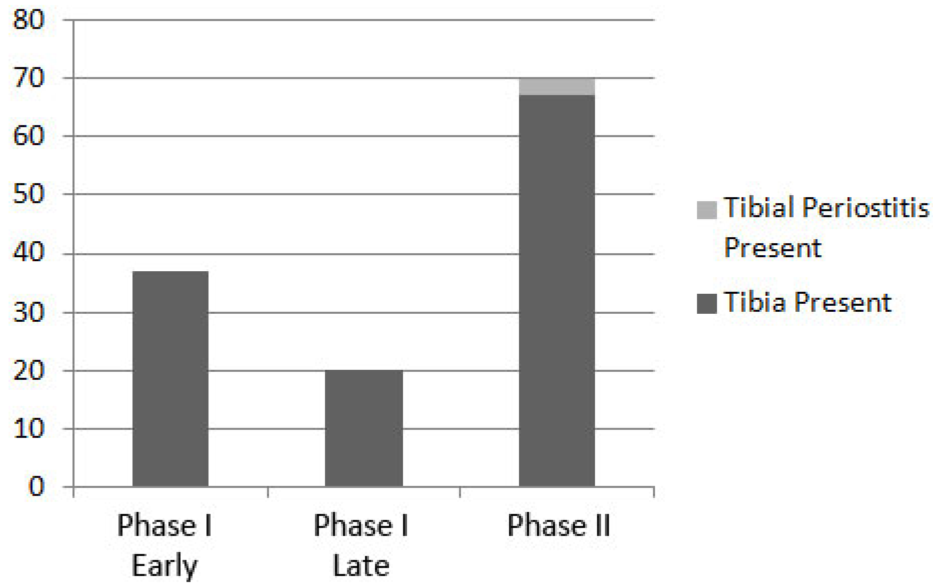

Figure 7. Frequency of tibiae and tibia periostitis present in project sample by phase.

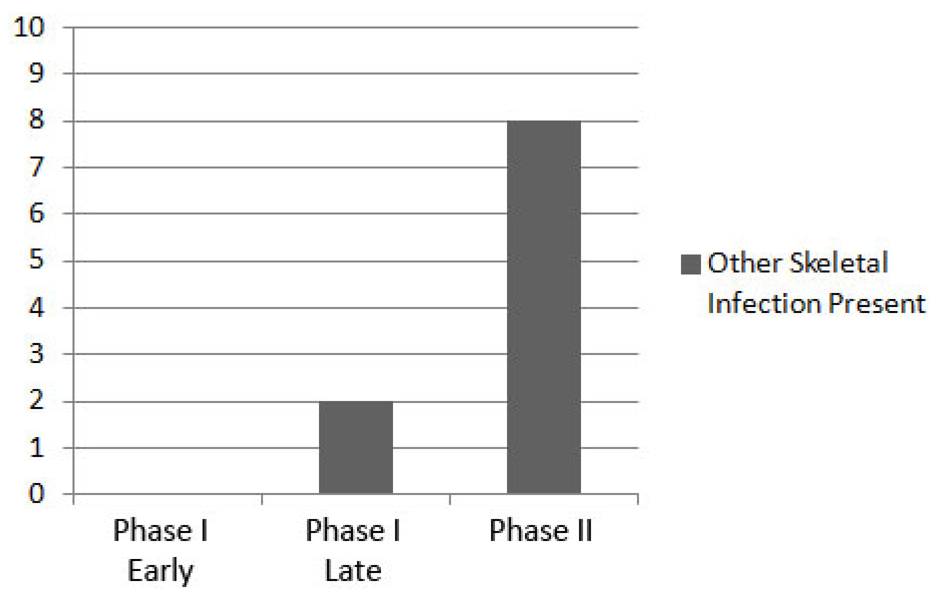

Figure 8. Frequency of other skeletal infections present in project sample by phase.

All logistic regression models failed to produce statistically significant results, meaning there were no significant differences between time periods for the occurrence of any of the included pathological markers. In all cases, the inclusion of the additional supporting data did not change the final model outputs (there was no increase in the strength of the model associations). This is likely due to either the insufficient amount of pathological variable co-occurrence (due to poor preservation and the lack of the presence of large amounts of pathologies), or the lack of a statistical relationship between the occurrence of any of the included pathological conditions.

In addition to examining changes in the frequency of skeletal markers of disease and nutrition, changes in stature were examined using two-tailed T-tests ($p < 0.05$). Adult stature was estimated for ~47% (127/271) of adult individuals (in cm, Table 1; Figure 6). No significant differences were found between the stature estimates of any project phase (all stature estimates are presented in cm). Modern stature data from Asturias, is also presented in Table 2.

Table 3. Pooled male and female statures by phase.

	Mean	S	*n*
Phase I Early	165.5	7.7	60
Phase I Late	165.1	6.1	16
Phase II	164.2	9.6	51
Asturias 1969-1986*	168	N/A	N/A
Spain 1969-1986*	170	N/A	N/A

*Data from Bosch et al. 2009

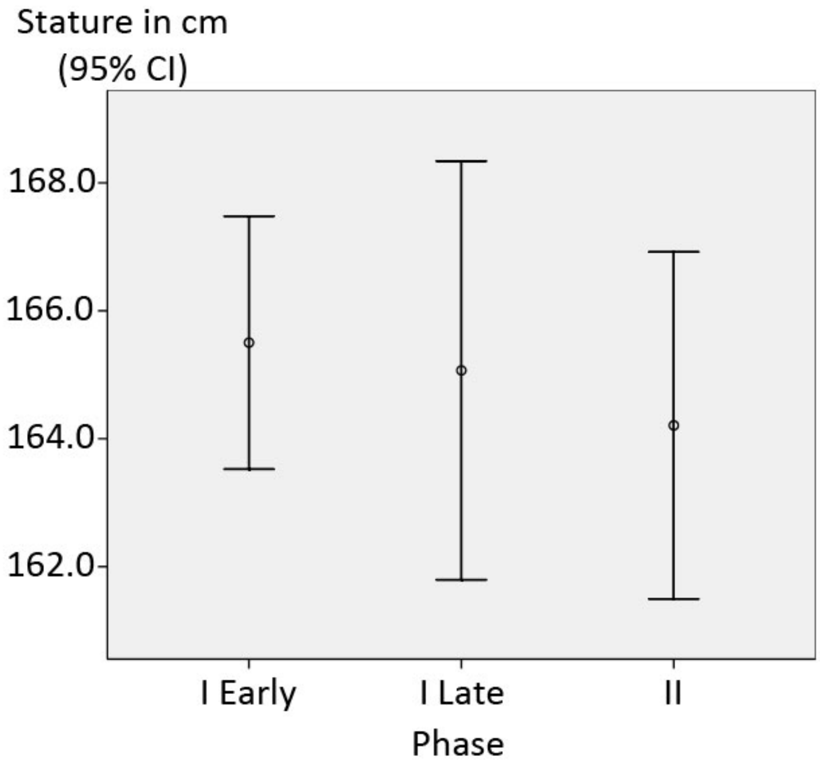

Figure 9. Stature estimates (in cm) by Phase.

Hypothesis II

The second hypothesis examined issues related to gender via estimates of biological sex. Stipulating, no differences would be found in the proportions of adult males and females, nor would there be significant differences found between sexes for markers of skeletal health or mortality in either Phase I or Phase II. Biological sex was estimated for ~76% (206/271) of adult individuals. Sex was not estimated for any subadult individuals (n=52) due to the inaccuracy of most methods and the differential preservation hampering sample-wide comparisons (Lewis 2007). Adult individuals without sex estimates are those which were represented by only bone fragments with no landmarks present for any included project measurements (n=65). Any individual lacking a sex estimate (subadults and poorly preserved adults) were not included in the following sex specific analyses. Sex estimates were designated as male or female for ≥ 80% posterior probabilities, and probable male or female when classified between 51-79% (for data, see Appendix 1). For all analyses that include sex as a variable, all probable assignments were treated as simply male (n=98) or female (n=108).

If sex was assigned randomly, we could expect a correct classification of ~50% of individuals. Overall correspondence between in-the-field general morphological sex assignments ("best guess eyeballing") and metric LCA classification is 82%. Thus it is likely safe to say that this method performs at a much greater classification accuracy than random chance, and is statistically supported unlike most morphological sex assignment methods. A previous study using finite mixture modeling (similar to LCA) by Konigsberg and Frankenberg (2007) obtained ~81% correct sex classification using only femoral circumference.

In order to compare relative proportions of males versus females, a chi-squared test was used. Results demonstrated no significant differences between the proportions for estimated biological sex ($p < 0.05$). Using the same logistic regression procedures described in Hypothesis I for the following variables: LEH, cribra orbitalia, tibial periostitis, other pathologies, no significant differences were found between males and females. Frequencies of all variables by sex are presented in Table 3 and Figures 7-11. Potential differences in stature were examined using two-tailed T-tests (Table 4; Figure 12). Significant differences in stature were found between males and females in Phase I Early and Phase II, but not for Phase I Late (likely due to the small sample size).

Table 4. Frequencies of skeletal markers of stress and disease present by sex.

Skeletal Marker	**Females**	**Males**
LEH Present	5 %	0 %
Cribra Orbitalia Present	2 %	8 %
Porotic Hyperostosis Present	0 %	0 %
Tibial Periostitis Present	4 %	0 %
Other Skeletal Infections Present (n)	4	6

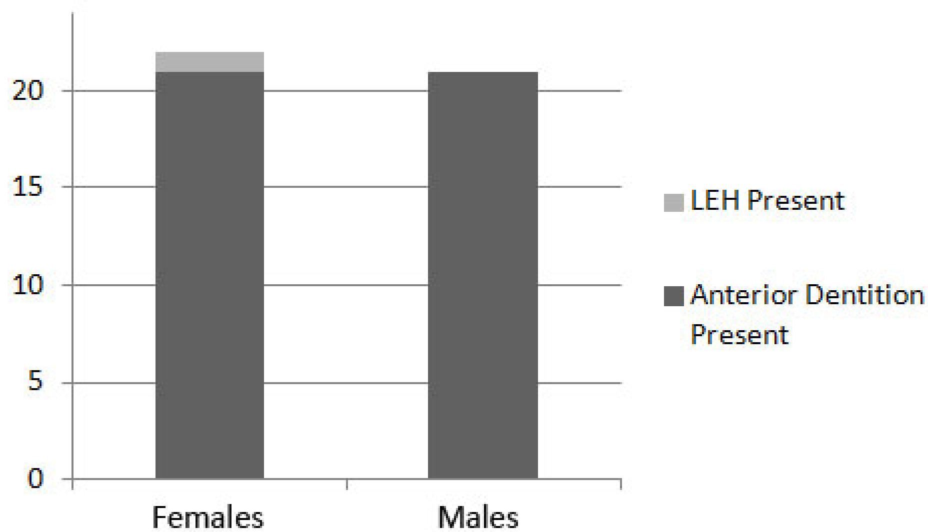

Figure 10. Frequency of anterior dentition and linear enamel hypoplasia present in project sample by sex.

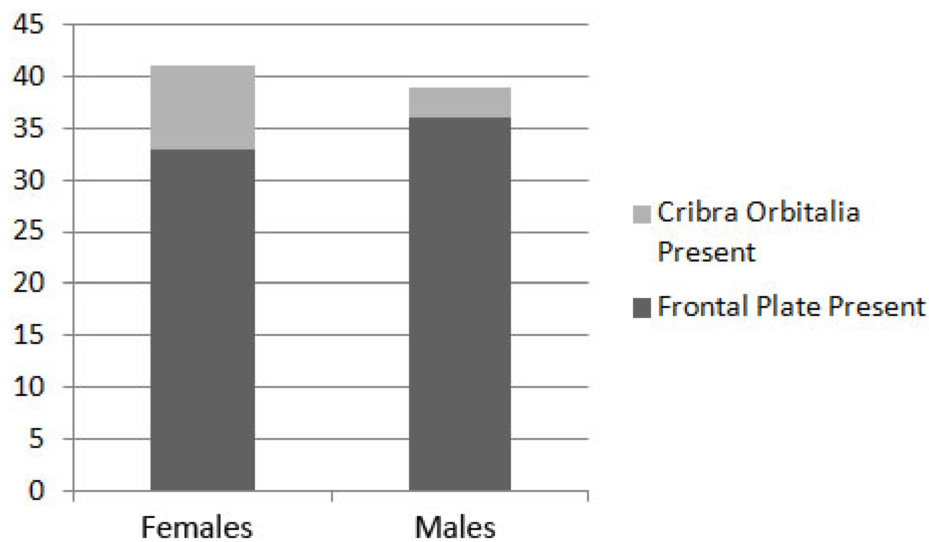

Figure 11. Frequency of frontal plate and cribra orbitalia present in project sample by sex.

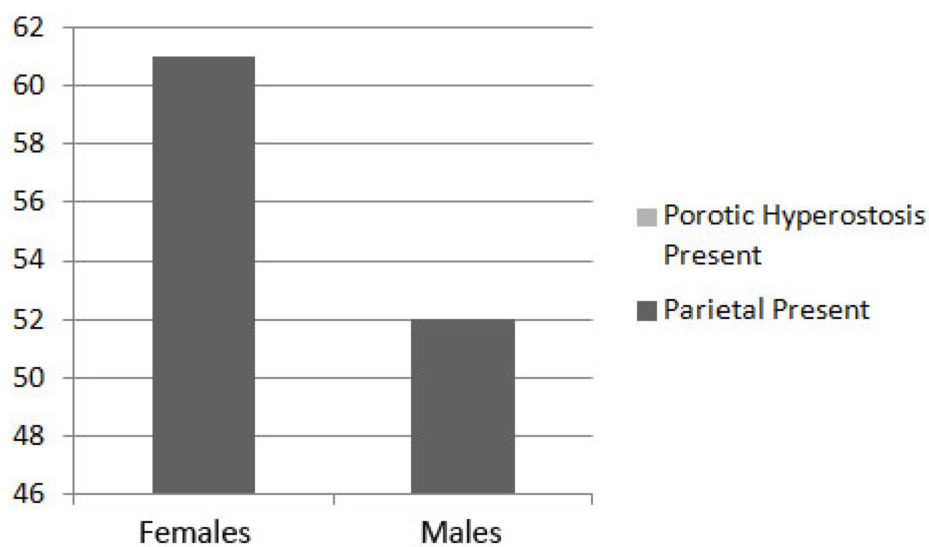

Figure 12. Frequency of parietal bone and porotic hyperostosis present in project sample by sex.

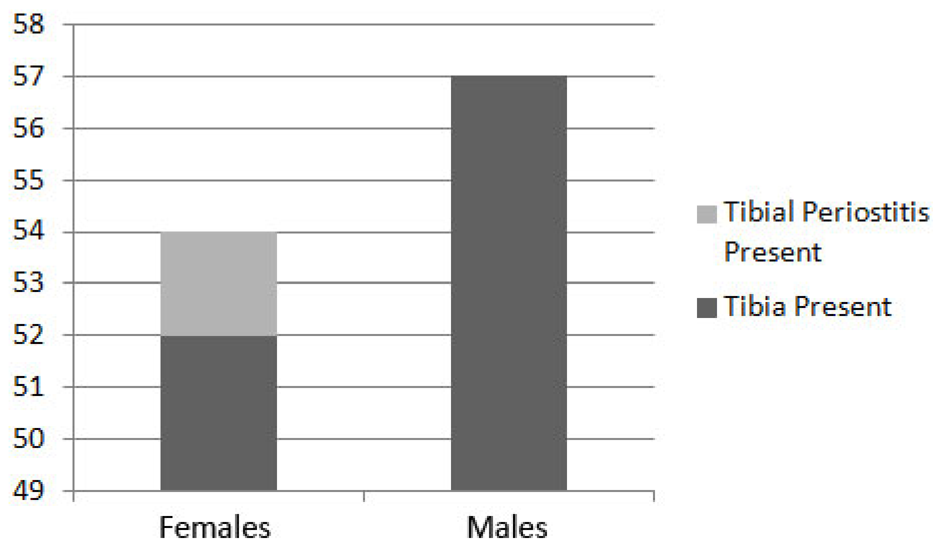

Figure 13. Frequency of tibiae and tibia periostitis present in project sample by sex.

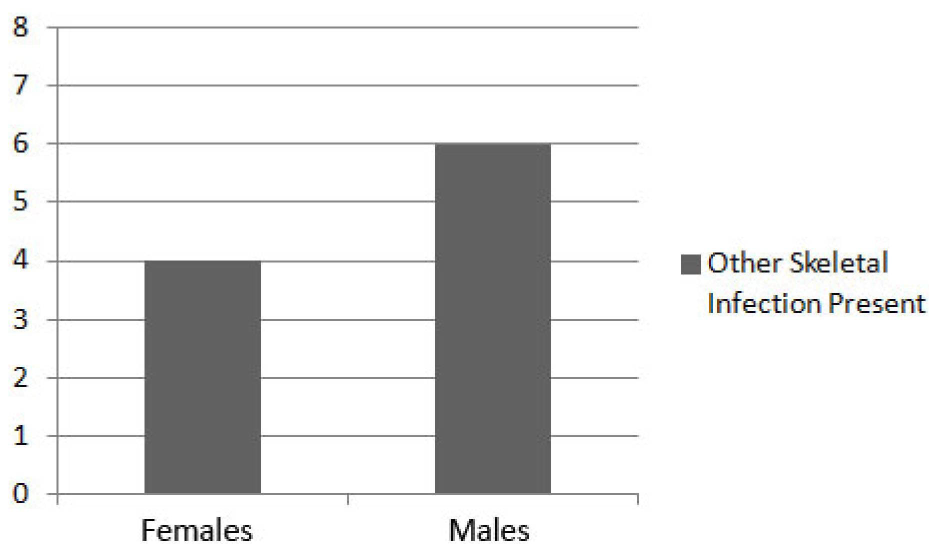

Figure 14. Frequency of other skeletal infections present in project sample by sex.

Table 5. Male and female statures by phase.

	Mean	S	*n*
Phase I Early			
Males	169	6.8	32
Females	162	6.6	28
Phase I Late			
Males	166.4	5.0	12
Females	161	8.2	4
Phase II			
Males	168.1	7.3	24
Females	161	10.3	27

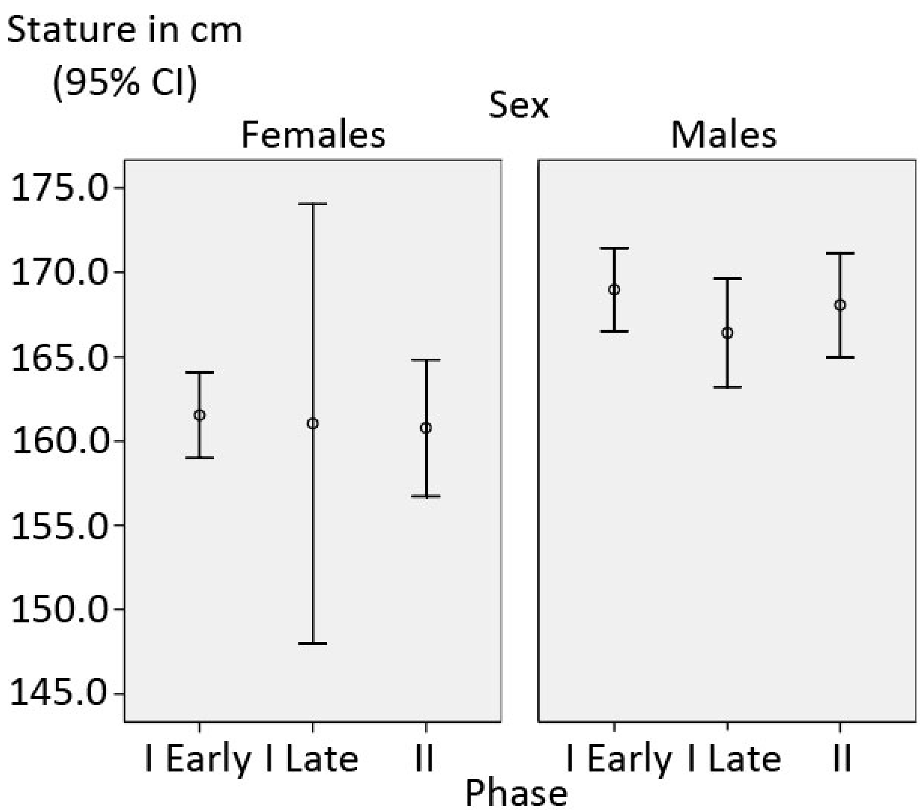

Figure 15. Stature estimates (in cm) by Sex and Phase.

Age estimates were generated for ~64% (206/323) of individuals (Figure 13). Individuals without age estimates are those which were represented by only long bone shafts or other partial fragments. While these individuals are unable to be assigned age estimates, these are likely adult individuals or individuals nearing adulthood (in their late teens) due to size and robusticity. In order to examine possible differences in mortality, a two-sample Kolmogorov-Smirnov test was performed. No significant differences in age were found between males and females for any phase ($p < 0.05$).

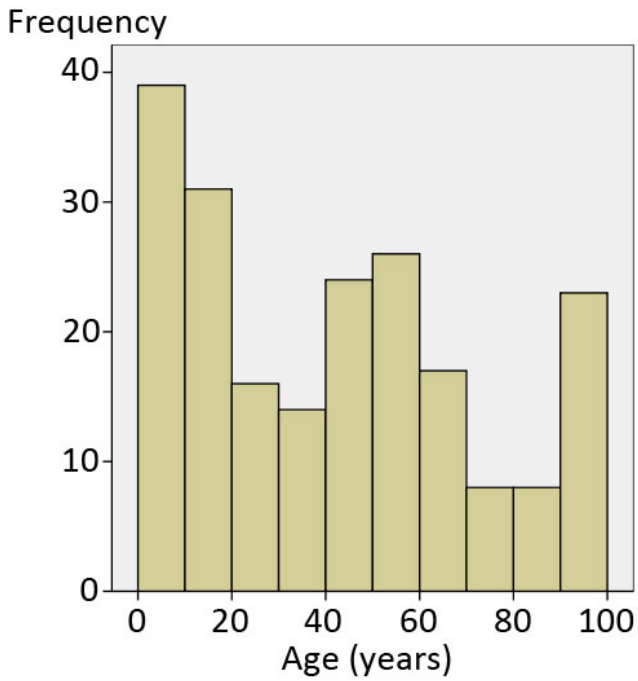

Figure 16. Age estimates (in years) of all individuals.

Hypothesis III

The third hypothesis examined issues related to social status via relative burial location, stipulating skeletal markers of stress and disease (LEH, tibial periostitis, cribra orbitalia, porotic hyperostosis, and other bony pathologies) will have lesser prevalence in individuals buried within church walls than those individuals buried outside church walls. Further, those individuals buried outside church walls will have significantly shorter adult statures related to reduced access to nutritional resources during development, and there should be a greater relative amount of subadult burials outside the churches as these limited resources may have resulted in increased frailty. Here common status refers to those individuals buried outside, while high status refers to those individuals buried within the church walls.

Using the same logistic regression procedures described in Hypothesis I for the following variables: LEH, cribra orbitalia, tibial periostitis, other pathologies, no significant differences were found between common and high inferred status individuals. Frequency plots of all variables are found in Table 5 and Figures 14-18. Adult stature comparisons between common and high inferred status individuals yielded no significant differences between inferred status, or any other status related groups (Tables 6-8; Figure 19). Only Phase II had large enough sample sizes to be sorted by phase, sex, and status, and to test for sample differences. While no significant differences were found between common and high inferred status males and females (see Table 5), females were very close to the significance level (P= 0.056).

Table 6. Frequencies of skeletal markers of stress and disease present by inferred status

Skeletal Marker	Common Status	High Status
LEH Present	11 %	8 %
Cribra Orbitalia Present	15 %	19 %
Porotic Hyperostosis Present	0 %	0 %
Tibial Periostitis Present	2 %	2 %
Other Skeletal Infections Present (n)	4	6

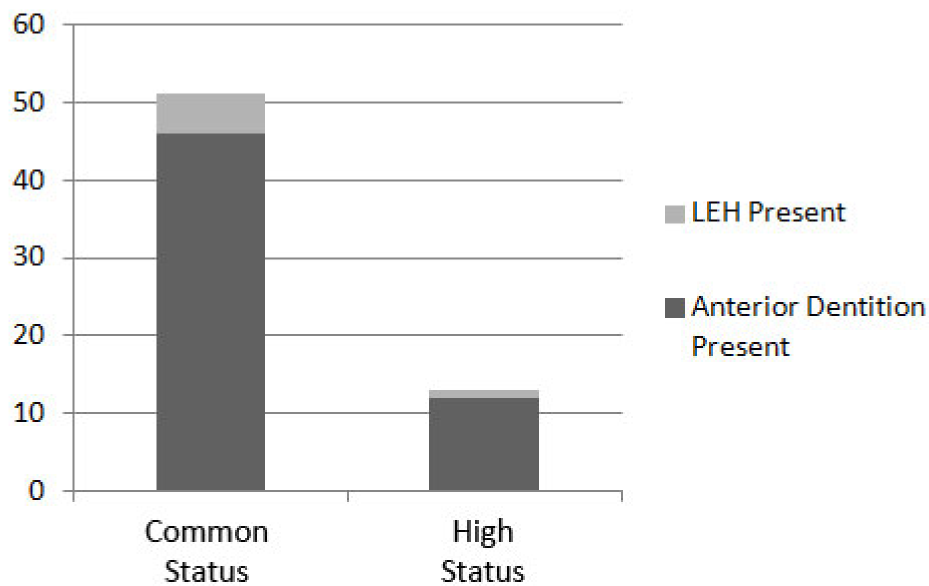

Figure 17. Frequency of anterior dentition and linear enamel hypoplasia present in project sample by inferred status.

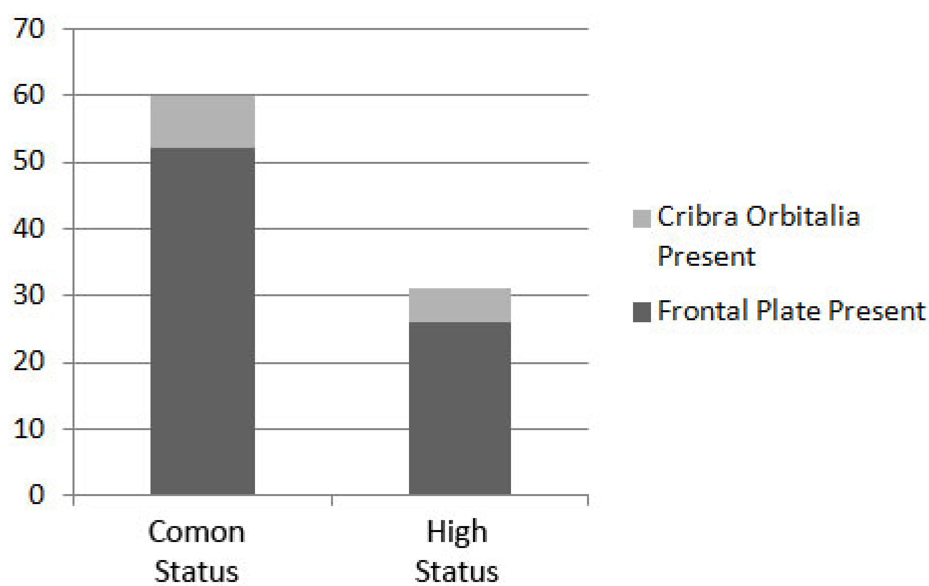

Figure 18. Frequency of frontal plate and cribra orbitalia present in project sample by inferred status.

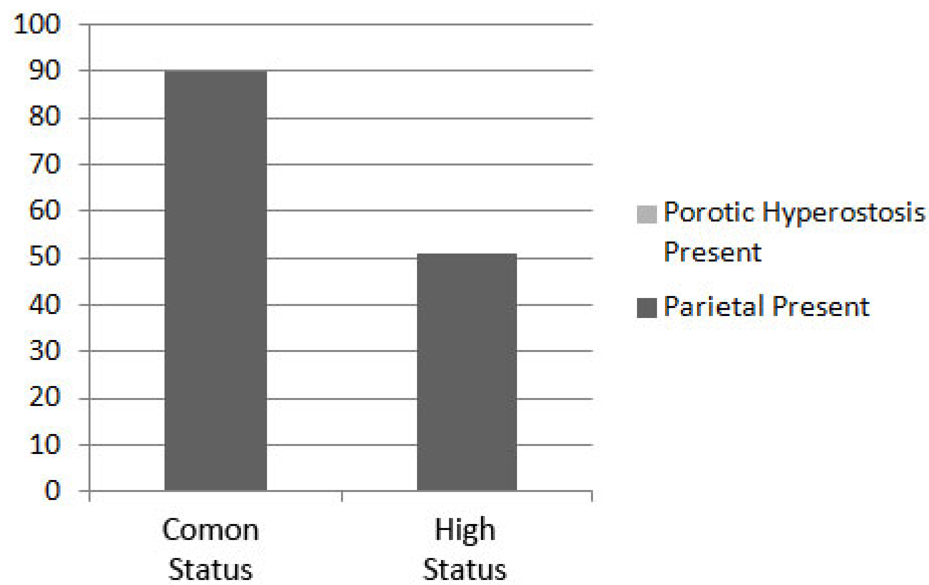

Figure 19. Frequency of parietal bone and porotic hyperostosis present in project sample by inferred status.

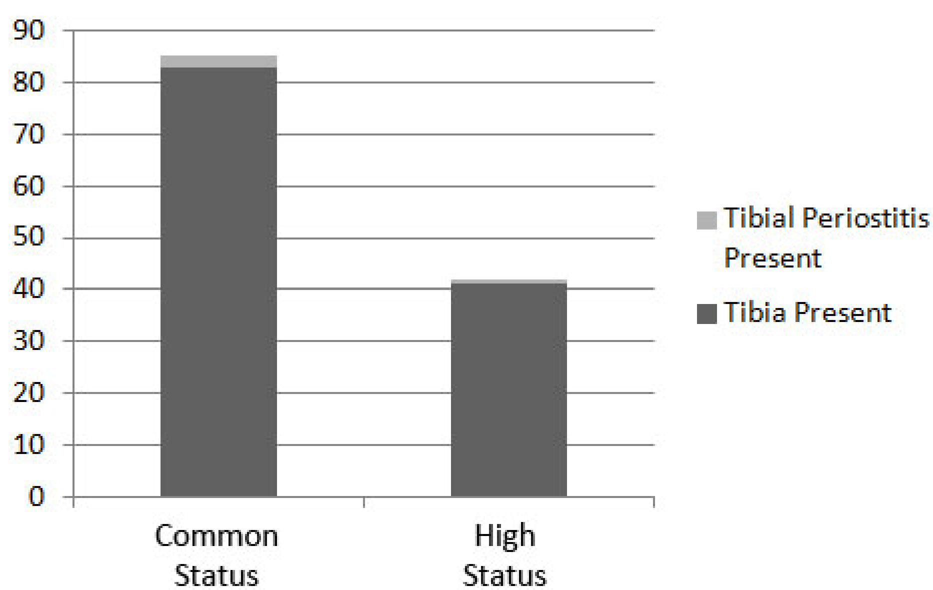

Figure 20. Frequency of tibiae and tibia periostitis present in project sample by inferred status.

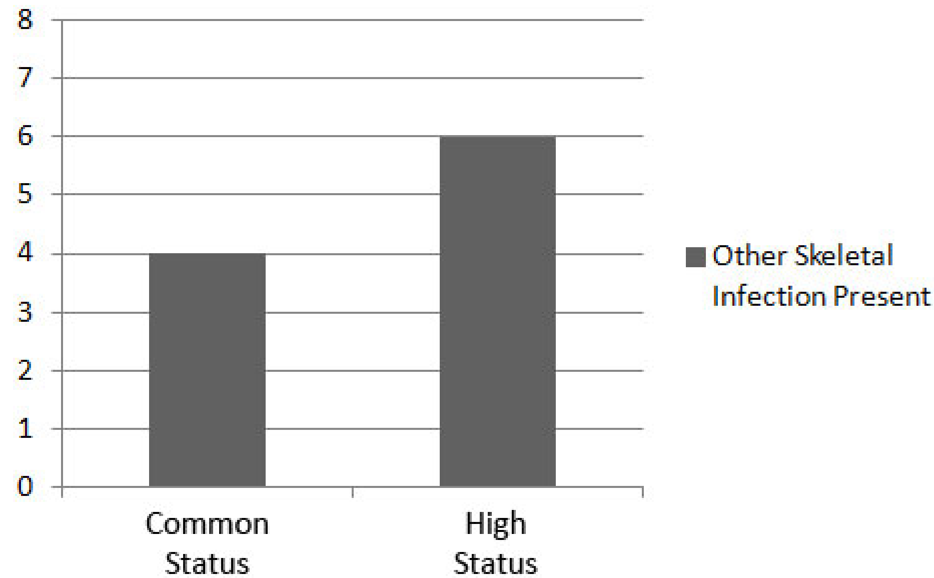

Figure 21. Frequency of other skeletal infections present in project sample by inferred status.

Table 7. Comparison of stature by inferred status.

	Mean	S	*n*
Common Status	165.5	8.4	73
High Status	164.2	8.2	54

Table 8. Comparison of stature of inferred status by phase.

Phase I Early	Mean	S	*n*
Common Status	165.7	7.7	55
High Status	163.4	7.3	5
Phase I Late			
Common Status	166.6	N/A	1
High Status	165	6.3	15
Phase II			
Common Status	165	10.9	17
High Status	164	9.1	34

Table 9. Comparison of stature of Phase II inferred status by sex.

	Mean	S	*n*
Females			
Common Status	165.3	11.8	10
High Status	158.1	8.5	17
Males			
Common Status	164.2	10.2	7
High Status	170	5.4	17

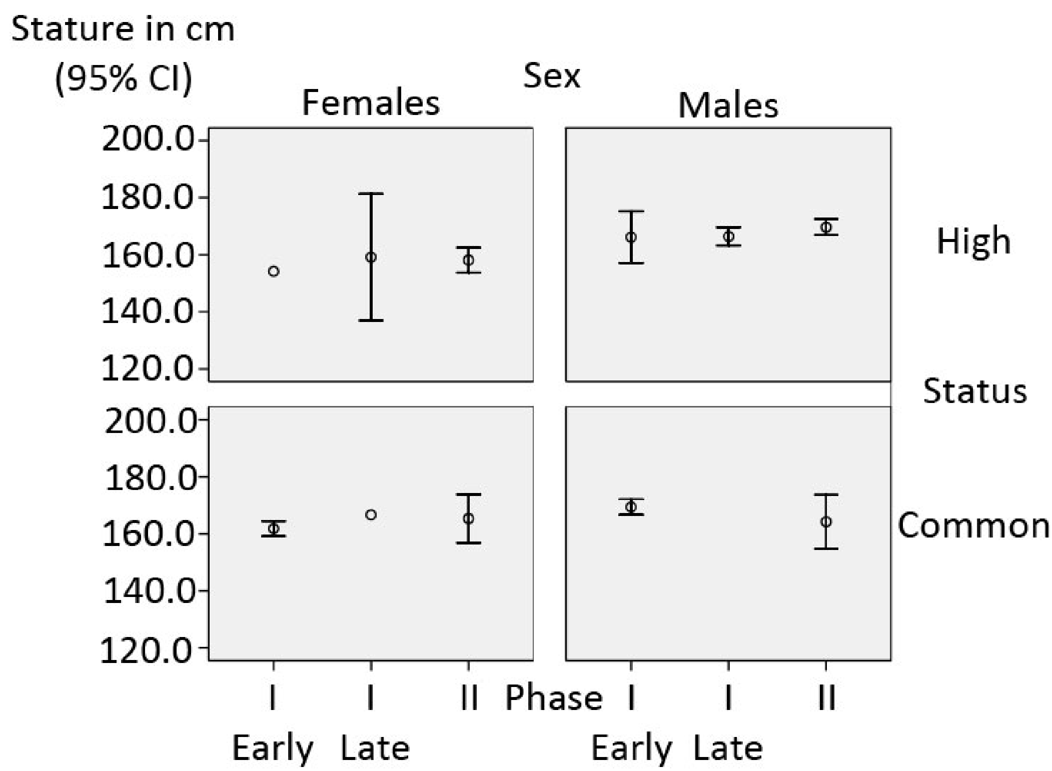

Figure 22. Stature estimates (in cm) by Phase, Sex and Status.

In terms of differing mortality rates by status, two-sample Kolmogorov-Smirnov tests were performed and found no significant differences between age distributions for any phase or between inferred site status ($p < 0.05$). No significant differences between age distributions were found between statuses within phases ($p < 0.05$). Further, potential shifts in subadult versus adult mortality rates were examined using subadult/adult (SA) ratios, generated for each phase, status and phase/status (presented in Tables 9 and 10). Adult individuals here included all individuals over 18 years of age (n= 67 subadults ; n= 256 adults). Subadult adult ratios were also generated from comparative Medieval Spanish sites found in Galera (1989). These data are presented in Table 11.

Table 10. SA ratio by phase and status.

	SA Ratio	*n*
Phase I early		
Common Status	26.2	82
High Status	16.7	7
Phase I Late		
Common Status	43.8	23
High Status	21.6	45
Phase II		
Common Status	26.5	129
High Status	27.6	37

Table 11. SA ratio for each phase and each status.

Phase	*SA Ratio*
Phase I early	22.2
Phase I Late	28.3
Phase II	24.8
Inferred Status	
Common	24.3
High	25.4

Table 12. Comparative SA ratios (from Galera 1989).

Site Name	*Site Location*	*Time Period*	*SA Ratio*	*n*
Ordoñana	Álava	Upper Medieval	69.2	44
Saint Eulalia	Álava	800-900 AD	18.8	56
Los Castros de Lastra	Álava	800 AD	87.5	45
S. Juan de Garai	Garai	1000-1200 AD	112.1	70
Saint Maria de Hito	Cantabria	800-1100 AD	41.7	292
Sepúlveda	Segovia	1100-1300 AD	11.1	140
La Torrecilla	Granada	300-1300 AD	48.9	140
San Nicolás	Murcia	1000-1200 AD	69.3	425

Health Index

Health Index scores for all sites are presented in Table 8. Health Index scores are rank ordered from 1-100 with 100 being the healthiest. Sites with cemeteries that that occur in multiple phases were treated independently by phase. Health index scores by phase and status are presented in Tables 12-15.

Table 13. HI scores by site.

Site	HI Score
Iglesia de Santa María de Villanueva	100*
San Juan (Phase I Early)	74.3
San Pedro de Nora	85.5
San Miguel de Liño	85.6
San Salvador De Cornellana	98.4
San Salvador De Valdediós	89
Casco Histórico de Villaviciosa Rehabbilitación	95.9
Ermita de San Lorenzo de Cortina	96.2
Iglesia de Santo Tomás de Riello	100*
San Pedro de Plecín (Phase I Late)	79.1
Catedral de Oviedo	91.1
San Juan (Phase II)	80.1
San Julian De Viñon	84.9
San Pedro de Plecín (Phase II)	85.3

*Note these scores appear to be erroneous due to insufficient data.

Table 14. HI score by phase.

Phase	HI Score
I Early	86.7
I Late	80.6
II	84.9

Table 15. HI score by status.

Status	HI Score
Common	86.1
High	81.9

Table 16. HI score by phase and status.

Phase	Status	HI
I Early	Common	87.8
	High	91.8
I Late	Common	95.8
	High	79.7
II	Common	82.3
	High	82.7

When the sites are ranked by relative date, the HI score does appear to dip ~1300 AD with San Pedro de Plecín (Phase I Late) and again with sites: San Juan (Phase II), San Julian De Viñon and San Pedro de Plecín (Phase II), all occurring ~1600 AD (Figure 20). The mean HI score for all project sites is 87, with a standard deviation of 7.4. No project sites fall outside of the two standard deviation range (72.4-101.8).

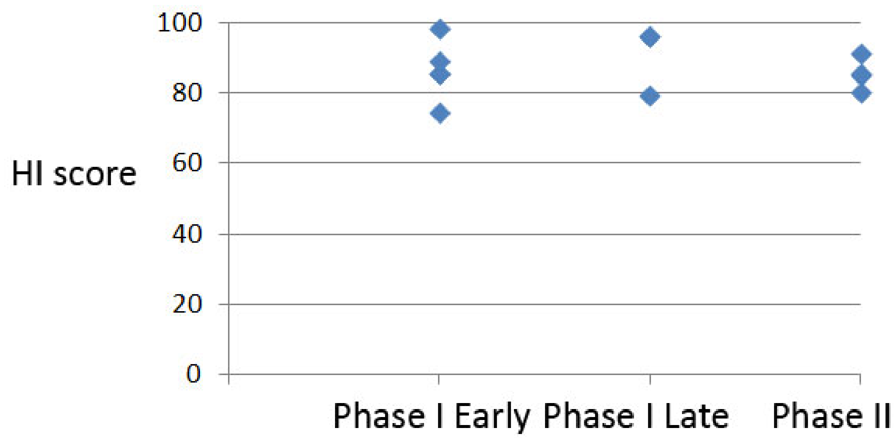

Figure 23. Project site HI scores, plotted by site phase. Note: sites Iglesia de Santa María de Villanueva, and Iglesia de Santo Tomás de Riello were not included due to erroneous scores.

Exploratory Model

In order to interpret the full dataset Exploratory Model (EM), three statistical measures must be used: Adjusted BIC(Bayesian Information Criterion), Loglikelihood (LL), and Entropy. Information Criterion (IC) statistics (here the adjusted BIC) are used to identify the correctness of the model (Nylund et al. 2007). Typically, the lower the IC statistic, the more correct the model. Because the potential amount of our latent classes for this model are unknown, the adjusted BIC was chosen (criteria which helps suggest what model performs best) as this statistic is a better indicator of numbers of classes than other information criterion measures under a variety of latent class conditions (Nylund et al. 2007). Further, unlike other information criterion measures, when the Adjusted BIC fails it tends to overestimate the number of classes present (Nylund et al. 2007:559). Nylund et al. (2007:562) argue that overestimating the number of classes is better than underestimating the number of classes as the extra class may not make sense or be very small, in which case the solution is often ignored and reduced to the next class solution (i.e. reducing four classes to three).

In addition to the adjusted BIC, LL and entropy will be used to determine best model fit. Overall, while there are no ideal numbers for either of these statistics the smaller the LL, the better the model. In addition, the closer entropy is to one, the more accurate the model fit (Celeux and Soromenho 1996). Model fit statistics are presented in Table 16.

Table 17. Model fit statistics for full dataset LCA.

Number of latent classes	Adjusted BIC	Loglikelihood	Entropy
2	827.2	-397.7	0.77
3	834.6	-393.4	0.53
4	846.6	-391.4	0.57
5	854.9	-387.6	0.56
6	866.3	-385.3	0.60
7	881.8	-385.1	0.52
8	894.8	-383.6	0.53

The clustering variables selected were: LEH, cribra orbitalia, tibial periostitis, other skeletal pathologies and stature. This limited the analysis to individuals that had at least one of these variables scorable (n=232). Based on these data, it would appear that a two-class solution may be the most appropriate as this model had the highest entropy value and smallest adjusted BIC and LL. Further, the additional solutions, did not have classes that appear to make sense, thus these models are likely overestimating the amount of latent classes present (Nylund et al. 2007).

For the two-class solution, class one (LC1) consisted of 13 individuals, while class two (LC2) encompassed the rest of the sample individuals (n= 219). In terms of traits, LC1 contained all individuals that had a LEH present (in the anterior dentition) (n=6) or a short adult stature (n=7). Of the seven individuals with stature estimates included in LC1, all fell far below the sample mean with an average z-score of -2.9, which is almost three standard deviations below the mean (Table 17). Most individuals (n=9) were from Phase II, although there did not appear to be a preference for inferred status. In addition, only four LC1 individuals were subadults, however no one aged above 25 years displayed a LEH which may be due to attrition in the anterior dentition and loss of the scorable area. Finally, while there was a strong bias towards female individuals in LC1 (n=7/8 with sex estimates), these estimates are likely incorrect as individuals with short statures are likely to have smaller measurements overall. Thus, because all the sex estimates for this sample were generated via LC metric analyses, these individuals would be assigned to the smaller (female) class when they may just be pathologically smaller individuals.

Table 18. Stature estimates for latent classes.

	Mean	S
LC1	146.8	2.9
LC2	165.9	6.6

Chapter 9. Discussion and Conclusions

Introduction

This project has endeavored to demonstrate that an effective bioarchaeological study does not always require perfect and complete sets of biological and archaeological information. For as the previous chapters have shown, in medieval Asturias the archaeological context was lacking and the skeletal remains themselves were often in poor preservation. Typically, in such a situation, any analysis ends up being what Konigsberg and Frankenberg (2007) refer to as: "*paleodemography under duress*." In the end, the prospect of an analysis of fragmentary or incomplete skeletal materials which do not allow the estimation of biological parameters via typical analyses, leads to these smaller collections being ignored or abandoned. Yet, by means of a unique combination of traditional research methods with new statistical models, the present project demonstrates that effective analysis of incomplete bioarchaeological evidence can still produce meaningful results. Even though the evidence for Asturias comes from small cemeteries throughout the area, aggregating these smaller samples from a contiguous region allows for broader conclusions to be made as well as a fuller discussion of the lifeways of past peoples (Armelagos 2003).

Based on these skeletal remains recovered from Asturias, Spain, three hypotheses were directly investigated. In addition, exploratory analyses to test for additional associations between variables that may not be overtly apparent based on the historical narrative were also employed.

Implications for the Results of Hypothesis I

The first hypothesis of this project was based on the expectation that the frequency of stress markers would increase across villages in the region of Asturias from Phase I early (~900-1300 AD) to Phase I late (~1300-1500 AD) during Spain's centuries of crisis and to continue this increase into Phase II (1500-1800 AD). In addition, this hypothesis predicted that markers of infectious disease would increase during the Spanish Empire (Phase II) due to increases in population density and consequent disease transmission. The stress markers investigated were: linear enamel hypoplasia (LEH), dental caries, cribra orbitalia, porotic hyperostosis and adult stature; the markers of infectious disease were: tibial periostitis, and other general infections (e.g osteomyelitis).

Contrary to the initial hypothesis, no significant differences were found for stress markers between Phase I early to Phase I late, or for Phase I late to Phase II. In addition, no significant differences were found for markers of infectious disease between Phase I early to Phase I late, or for Phase I late to Phase II. The implications of these results are that there were no (significant) changes in the overall health of individuals living in Asturias, Spain from ~900 - 1800 AD.

Much of the historical evidence for the potential decreases in health over time came from arguments by Ruiz (2007) and Lynch (1991; 1992). Both historians demonstrated that subsistence crises due to poor harvests and low yields were frequent after 1300 AD producing malnutrition and reduced resistance to infectious disease as well as the timing of the Centuries of Crisis (Ruiz 2007; Lynch 1991). Additionally, Lynch (1992) argued Spanish subsistence crises began again in the early 1600s AD after a brief respite during the establishment of the Spanish Empire.

The lack of significant discrepancies in health associated with the Spanish Crisis (Phase I early to Phase I late) or the Spanish Empire period (Phase I late to Phase II late) suggests that (1) individuals in Asturias faired no worse during these periods of increased famine and unrest than usual, or (2) that the famine and unrest so commonly discussed in historical accounts did not significantly occur in Asturias compared to other, more populous regions. Interestingly, many historians (e.g. Lynch 1991; Ruiz 2007) support the notion that the northern mountainous Spanish communities were unaffected by the increased problems found in the more urban southern areas, however this had yet to be demonstrated bioarchaeologically (Lynch 1991; Ruiz 2007). The etiology of this trend is currently unclear. Whether this consistency in biological health is due to the insular nature of these rural village populations requires additional research. Jenny (2011) found fewer individuals with pathological indicators (LEH, cribra orbitalia, tibia periostitis, and maxillary sinusitis) in rural cemeteries than contemporary urban cemeteries in Roman Britain. So these rural village sites may have been spared the spread of disease and stress found in contemporary urban areas such as Madrid or Toledo. Overall the amount of physiological stress indicators (LEH, cribra orbitalia, porotic hyperostosis) and markers of disease (tibial periostitis, other infections) occur in much lower frequencies in the Asturian population than in other nearby Spanish regions (e.g. Galera 1989).

Discussion of Results for Hypothesis I

The fact that cribra orbitalia was observed in ~15% (n= 14/91) of the population, but porotic hyperostosis was never observed (n=0/141) suggests that the lesions may be the result of vitamin C deficiency rather than megaloblastic anemia (Ortner et al. 1999; Andrushko 2007; see below for further discussion). In comparison, Galera (1989) found much higher rates of cribra orbitalia (between 40%-90%) at another northern Spanish site (Villaverde de Hito, ~50km from the eastern boarder of Asturias). Vitamin C deficiency can occur as a result of malnutrition (Andrushko 2007; Walker et al. 2010), and thus may reflect issues related to weanling diarrhea or periods of famine in these populations.

In regard to famine and crop yields, the majority of Spanish peasants cultivated cereals, fruits, and vegetables with intensive irrigation, but were forced to use simple primitive tools due to the lacking availability of more modern technologies in comparison to other areas of Western Europe (Lopez et al. 2012). Lynch (1991:151) argues that during the Medieval period in Spain, most peasants lived on the margin of subsistence and had sufficient yields only to feed their families once they had paid all their obligations to the state, the church, and the landlord. Surplus only came from extra work, such as the domestic industry (Lynch 1991:151) and rents were continuously raised after the 1570s AD as prices for grain increased with inflation. “Evidence suggests that charity (mostly via monasteries) was not enough and could not prevent a steady deterioration of the health and living conditions of the poor (Lynch 1991: 151).” Further, in areas where the plague had killed many people, there may not have been enough laborers in good health to work the land or harvest crops and this would have created food shortages (Fernández et al. 2009). Any of these factors could have contributed to nutritional deficiencies found in the Asturian subadults.

Interestingly, just as the rates of cribra orbitalia (associated with malnutrition) remained constant over time, so did the estimates of adult stature (associated with net nutrition). It would thus appear that there were no significant changes in the amount of available nutrition for subadults via crop yields during the project period, or if the population did increase, this likely occurred along with any possible increases in crop yields and effectively maintained a similar level of biological stress in the Medieval Asturian population.

Secular changes in height are associated with increased nutrition and access to resources. The lack of evidence for secular changes in height over the previous 900 years of the project data is peculiar, however other research regarding the topic in Spain is lacking. It may in fact be the case that secular changes in height, which are well documented as occurring within the last 100 years or so, are due to the overcoming of some biological threshold in relation to nutrition, and that the previous minor improvements in nutrition may not have resulted in significant height increases. Additionally, while there do not appear to be significant changes in height, it is possible that there may be other significant secular changes occurring. For instance, secular changes in overall robusticity and the cranio-facial region have been previously documented in other populations but not investigated in the present population (e.g. Spradley 2006).

Despite the lack of evidence for significant secular changes in height during the project period, contemporary stature estimates for height demonstrate that significant changes (~3 cm) have occurred at least between the end of the project period (~1800) and the late 1900s AD. In regard to stature comparisons, contemporary Asturias has the shortest adult stature out of 18 sampled regions of Spain (Bosch et al. 2009). It should be noted that the Bosch et al. (2009) data is self-reported living stature and may thus be biased (see Ousley 1995 for further discussion), however the skeletal sample estimates are for forensic stature (Ousley 1995). Because forensic stature attempts to take into account biases in reported stature, any overall bias when comparing the two measures should be minimal.

Potential etiologies for the lack of porotic hyperostosis and presence of cribra orbitalia

In terms of skeletal pathology, malaria is often associated with the presence of porotic hyperostosis and cribra orbitalia (Andrushko 2007; Ortner 2003; Walker et al. 2009) due to the disease's effect on hemoglobin and the development of related anemias (Ortner 2003). Malaria is considered an endemic tropical parasitic disease (Rubio et al. 1999; Sousa et al. 2009) caused by the plasmodium parasite (Ortner 2003). Malarial environments are typically wet, humid areas which contain standing or slow moving water (Sousa et al. 2009), as suggested by the etymology of the Spanish word for malaria: "paludismo", which is derived from the Latin "Palus" meaning "swamp" or "pool" (Corominas 1997; Sousa et al. 2009). Malaria was present in Spain until its eradication 1962, but was most frequently found in the southwest regions of Extramadura and Granada (Rubio et al. 1999). On the other hand, it appears to have been absent from the more northern Spanish regions such as Asturias and Galicia likely due to the lack of humid wetland environments in these regions (Sousa et al. 2009).

Another potential cause of cribra orbitalia is Vitamin C deficiency (scurvy) (Ortner 2003). Vitamin C deficiency is typically caused by a diet lacking ascorbic acid although weanling diarrhea or disease may also cause a lack of appropriate vitamin absorption (Brickley and Ives 2006; Andrushko 2007). In infants and children, clinical vitamin C deficiency can develop as soon as two months after the disruption of a vitamin C diet (Tamura et al. 2000). This rapid response compared to adults is due to the high growth rate of childhood (Stuart-Macadam 1989).

Vitamin C is present in marine fish, vegetables, and fruits (Aufderheide and Rodríguez-Martín 1998). While all of these resources were likely available year round in medieval rural Asturias, it is possible that a shortage could occur during a famine or harsh winter months.

Because these resources were likely regularly available, the cause of cribra orbitalia in this population would appear to be due to a lack of appropriate vitamin absorption via weanling diarrhea or disease (Ortiz 1971; Lopez et al. 2012). However, unlike the orbital lesions more often associated with scurvy due to deficiencies in connective tissues (see Walker et al. 2009), the porosity present in most individuals from this sample occurred in the orbital plate itself, not extending out from the orbital plate due to the osteoblastic activity of hematogenous ossification. This may suggest another etiology of the orbital porosity rather than scurvy, such as general growth disruption of these bony tissues, however this is currently ambiguous.

Implications for the Results of Hypothesis II

The second hypothesis of this project stated that there would be no significant differences in the proportions of adult males and females, nor would there be significant differences between sexes for markers of skeletal health or mortality in either Phase I or Phase II.

Chi-squared tests found no significant differences between the proportions of the estimated biological sexes. In addition, there were no significant differences found between males and females in regard to age-at-death distributions and no significant differences were found between males and females for skeletal markers of stress or infectious disease.

Medieval Spanish society was patriarchal and women spent much of their time in the home caring for their children and performing other domestic tasks (Fernández et al. 2009; Bennett 2005; Miller 2003; Gies and Gies 1978). It would appear that historians (e.g. Gies and Gies 1978; Miller 2003; Bennett 2005) tend to expect females to have decreased access to nutrition, healthcare and education, while bioarchaeologists (e.g. Galera 1989) tend to find no significant differences in skeletal markers of stress and disease between the sexes. Using similar methods as this project, Galera (1989) found no significant differences mortality or markers of stress in regard to sex. The work by Lopez et al. (2012) appears to agree with both parties; finding no sex differences in dental health until the Spanish Empire ("Modern") Period when it would appear that dental care begins to be differentially available to males over females.

The present results confirm the previous bioarchaeological findings that biological health for females does not appear to differ significantly from males within Medieval Spanish society. Thus it would appear that any effect on biology that the patriarchal nature of Medieval Asturian (and likely Spanish) society had was minimal. This is not to say that Medieval Spain was not patriarchal, simply that this sex-biased society did not result in significant health disparities for women compared to men. Many of the stress markers found in this population occurred in subadults and due to the inability to accurately determine sex in these young individuals, subadults were excluded from the sex specific analyses. This means that if sex-biased access to nutrition occurred at very young ages, this was not detectable in the present sample due with the current methods used. Future research with more accurate sex determination methods such as DNA analysis, could shed additional light on this issue.

Discussion of Results for Hypothesis II

The areas investigated in other previous bioarchaeological research (Galera 1989; Lopez et al. 2012) are relatively different from Asturias, Spain; falling outside the mountainous terrain of much of northern Spain. However, the present results support their general conclusions. Lopez et al. (2012) did find differences in accessibility to dental healthcare in beginning in the Spanish

Empire period, however this has yet to be investigated in the present sample, or any other Asturian samples. A confounding factor for investigating access to dental healthcare in the present sample is the fact that in the current project, adult ages were estimated using dental attrition while factoring in antemortem tooth loss as a function of this process. Because of this, the biological age estimates would not be reliable for these other analyses and other (likely histological) methods would need to be employed to investigate changes relative to age classes.

Interestingly, DeWitte (2010) suggests that females may be better at dealing with physiological stress than males. Essentially, DeWitte (2010) found that average differences in frailty result in differential mortality responses in males and females based on the same physiological stressors. Further, DeWitte (2010) comments that there is a strong trend for males to be more susceptible to diseases caused by bacteria and viruses than females (e.g. Noymer and Garenne 2000). This is a complex issue as the results suggest that while males and females may have equivalent observed frequencies of skeletal stress markers, this may be due to differential frailty depending on the cause of death. Because the current samples are aggregated by region and display poor skeletal preservation, this is not an ideal situation to investigate DeWitte's (2010) conclusions. It should be noted, however, that sex-biased frailty may be present in this sample thus potentially skewing the results.

Implications for the Results of Hypothesis III

The third hypothesis of this project was that skeletal markers of stress and disease (LEH, tibial periostitis, cribra orbitalia, porotic hyperostosis, and other bony infections) will have lesser prevalence in individuals buried within church walls than those individuals buried outside church walls. In addition, because *ad sanctos* burial should reflect wealthier families, we should expect to find adults with shorter statures outside the church walls (due to reduced access to net-nutritional resources) as well as a greater number of subadults compared to adults (due to increased frailty) because those families with less income/access to resources would not be buried in prestigious locations.

Contrary to the stated expectations, there were no significant differences found between those individuals buried outside church walls versus those individuals buried within church walls in terms of skeletal markers of stress or infectious disease. In addition, there were no significant differences found between the age-at-death distributions for either intra- or extra- ecclesia groups, however the SA ratio suggests a significant increase in subadult burials for common status individuals in Phase I Late. Finally, although there were no significant differences in adult stature (reflecting subadult net nutrition) between inferred status burial groups (by phase, or sex), the differences in stature for Phase II females did approach significance.

The general lack of significant findings here suggests interesting results in terms of biological health and its relationship to social status. While *ad sanctos* burial was a common mortuary custom found throughout Western Europe and Spain during the Medieval period, based on the results of this study, it does not appear to correspond to biological markers of health in a meaningful way in Asturias. The practice of *ad sanctos* burial suggests that those individuals buried within a church should have a greater social prestige in comparison to their counterparts buried outside the church. Social prestige is often associated with wealth, which is directly related to access to nutritional resources (Robb et al. 2001). If the individuals buried within churches are not significantly healthier than those individuals buried in the common cemetery church yard, then it suggests that either: (1) there were no actual biological differences between common and high status individuals in Asturias, Spain, (2) the bioarchaeological methods for investigating health used here were not precise enough to detect these minor differences or (3) the conditions required for intra-ecclesia burial were not restrictive enough to only include those individuals with significantly differential access to resources.

Each of these conclusions have interesting ramifications. If (1) there were no actual differences in biological health between the common and high status individuals, then this suggests that regardless of status, individuals were able to meet their nutritional needs in a satisfactory way. While it may be the case that higher status individuals were eating finer, more expensive foods than the lower class individuals, this discrepancy may not have resulted in significant health differences using the present indicators.

If (2) the bioarchaeological methods for investigating health used here were not precise enough to detect these likely minor differences in biological health, then this suggests that bioarchaeological research regarding health in relation to status must be reconsidered (see Robb et al. 2001). Studies using similar methods such as Milligan (2010), Jenny (2011), Powell (2007), Robb et al. (2001), Šlaus (2008), and Soler (2011) also failed to detect significant differences in skeletal health when historical sources suggested such discrepancies. What may be occurring in these circumstances is not simply the absence of health discrepancies between the target populations, but the lack of significant findings due to the robust nature of the data collection methods, combined with the comparison of populations which are too homogeneous in their encounters with, and reactions to, physiological stressors. This may also be the case with the conflicting results from the two-sample Kolmogorov-Smirnov tests versus the SA ratios, at least for Phase I Late common status individuals. Isotopic investigations of diet may better reflect these minor discrepancies in access to nutrition and resources, or further confirm a lack of significant differences in status, however further research is required on this matter.

Interestingly, Robb et al. (2001) attempted a similar investigation of social status using biological markers from Italian cemetery samples dating to the Bronze Age. Robb et al. (2001) found that many traditional markers of health (e.g. LEH, cribra orbitalia and adult stature) were not associated with the inclusion of grave goods, but that the grave goods were associated with skeletal indicators of activity and disease (e.g. skeletal trauma, Schmorl's nodes, periostitis). This may suggest that nutrition and frailty may actually be more associated with what are more commonly considered markers of activity rather than markers of health, or that status was perceived differently than we may be assuming today. Another recent study (Peterson et al. 2010) suggests that the development of osteoarthritis may be more linked to early malnutrition than activity patterns, at least in Moose populations. The results of Peterson et al. (2010) are noteworthy, because they suggest that some skeletal variables which are commonly considered to be markers of activity may actually be more associated with health, however this requires further investigation.

If (3) the conditions required for intra-ecclesia burial were not restrictive enough to those individuals with differential access to resources, then our interpretations that higher status and wealth are associated with prestigious burial status in regard to *ad sanctos* burial must be reconsidered. From a historical perspective, Bango Toviso (1992) argues that this may be the case after the 1500s AD when a large increase in *ad sanctos* burials begin to occur. Bango Toviso (1992) notes that after the 1500s AD, "saintly life" is enough to make someone an "honored man" who is then granted intra-ecclesia burial. However it is unclear what this "saintly life" might entail, and it may not be a stretch to assume that poor and unhealthy individuals may be just as likely as wealthy and fit individuals to be buried within the church walls based on such different criteria for inclusion in this prestigious burial location. In addition Beaver (1998) suggests other reasons why an individual may be buried within a church unrelated to wealth (see Chapter Four). Because it is possible that the burial conditions for these un-wealthy individuals occurred within Medieval Asturian churches alongside *ad sanctos* burial, it may not be possible to differentiate between the intra-ecclesia burial conditions.

Discussion of Results from Hypothesis III

Subadult/adult (SA) ratios were employed in order to examine potentially changing relationships in subadult survivability (frailty) by phase and status. It should be noted that while in this study adults were considered to be any individual with a mean age estimate of 18 years or older; culturally speaking, individuals from these sites were likely treated as adults from as early as 14 years of age (Fernández et al. 2009). This means that potentially some individuals were being treated as adults due to their cultural status, however the skeletal record interprets them as subadults. This could result in a systematic bias or skewing of results depending on the mortuary treatment these individuals received. Further, it may have increased the frailty of these young individuals through a more physically demanding lifestyle while they were still maturing.

In regard to interpreting the SA ratios, all of the project SA ratios were similar, ranging from 16.7 - 27.6, except one. The single outlier was Phase I Late with common (peasant) inferred status (SA ratio= 43.8). The value suggests a high (almost 50/50) subadult mortality rate. The cause of the relative increases in common subadult deaths for this period is unclear, but may be due to increased stress and pathogen load from Spain's Centuries of Crisis. If this is the case, then it suggests that subadult mortality may be the only variable that significant changes during this period of famine and strife, or that subadult mortality is the only variable sensitive enough to demonstrate change at this level of inquiry. With this result from the Subadult/Adult ratio, the lack of significant differences between age-at-death distributions is puzzling and suggests that either the Kolmogorov-Smirnov tests are not sensitive enough to detect these differences, or the change in the Subadult/Adult ratio is not truly significant in terms of the overall age-at-death distribution.

The Asturian SA ratios suggests a slightly increasing subadult mortality rate over time, with no differences based on inferred status. This may be explained by (1) increased stress on subadults due to overall population increases (having more children increases the amount of resources needed which may not be available), (2) increased rates of disease which differentially target subadults and older individuals, (3) by changing mortuary customs, with more subadults being buried in locations that are later excavated and recovered, or (4) by increased preservation rates as the fragile subadult bones are not exposed to the burial conditions as long as the earlier sites. With no historical support for (3) changing mortuary customs, the most likely of these scenarios is either (4) better preservation of skeletal elements due to less time exposed to diagenetic factors, or (1) possibly population increases as supported by Kamen (2005:244) and Lynch (1992:8), although none can be fully ruled out.

In addition, the results of the SA ratios may also be spurious due to differences in recovery procedures or other related factors. When compared to SA ratios generated from comparative samples from other Spanish regions (Galera 1989), it would appear that the potential for sample of this statistic bias increases. No trends in the SA ratio are present in the comparative data, nor are these data similar to the Asturian site data. While it is possible that the

SA ratios are accurate and just very context specific, it appears more likely that the SA ratio is too dependent on variations in sample individuals and thus unreliable.

Fernández et al. (2009) suggest that most parents had seven or eight children, but the lack of hygiene and healthcare (aside from periods of malnutrition) increased infant mortality to the point that less than half of subadults survived to age 10. For subadult mortality to be this high, there would need to be a large number of subadults that are unaccounted for in the archaeological record. While children are typically assumed to be underrepresented in bioarchaeological recoveries (Lewis 2007), by the estimate of Fernández et al. (2009), the SA ratios would need increase tenfold (e.g. 27.6 to 276). Having a disparity to this degree would not appear likely without further information suggesting differential treatment of infants, thus the Fernández et al. (2009) numbers would appear to be significantly over estimated.

Discussion of Results from the Exploratory Model

In order to test for additional associations between variables that may not be overtly apparent based on the historical narrative, exploratory analyses were also employed. Here latent class analysis (LCA) was used to investigate any clusters of variables that may be significant, but not overly apparent from the historical narrative. The two-class LCA model had the strongest adjusted BIC, loglikelihood, and entropy values and was thus considered to have the best model fit. The solutions with greater numbers of latent classes did not have any apparent trends in the data and therefore, these models are likely overestimating the amount of latent classes present (Nylund et al. 2007). For the two-class solution, LC1 consisted of 13 individuals, while LC2 encompassed the rest of the sample individuals (n= 219). In terms of traits, LC1 contained all individuals that had a LEH present in their anterior dentition (n=6) or a pathologically short adult stature (n=7). The pathological statures fell on average three standard deviations below the sample mean, which is well outside of 99% of the sample variation.

Similarly, when examining individuals with stature estimates one standard deviation above the mean or greater, similar trends follow for those individuals that classified into LC1 in the LCA modeling. While there did not appear to be any trend by phase or status, most individuals (n=20/23) were classified as male, similar to those very short individuals from LC1 being classified as females. Because all the sex estimates for this sample were generated via LCA metric analyses, these individuals would be assigned to the larger (male) class when they may just be larger individuals. Importantly, it is unlikely that these taller individuals represent a different population, as they are all still within two standard deviations from the mean and thus not significantly different from the rest of the population. In fact, no individuals fell above one standard deviation from the mean, suggesting that the amount of variability found in these larger (taller) individuals is not so different from the rest of the population.

The significance of the pathological individuals falling into LC1 is that the LCA is able to sort out some level of antemortem health status of pathological individuals from the general sample population. Unfortunately, other than the individuals of LC1 all having a LEH present or pathologically short adult stature, there does not appear to be any meaningful relationships present within this cluster of individuals. This may be partially due to the fact that the sex of the individuals cannot be reliably ascertained due to the methods employed and skeletal elements present, however no trends in temporal phasing or inferred status are apparent either.

Discussion of Results from the Health Index

The Health Index score (Steckel et al. 2002) was used here in order to compare the project results with those from similar contexts. HI scores were generated by phase, inferred status, phase *and* inferred status, and for each project site. In terms of HI score by phase, Phase I early had the highest score (86.7), Phase I late scored lower (80.6) and Phase II (84.9) had a score in between the former two. Interestingly these results do correspond to the general health trends predicted in Hypothesis I. However, in terms of inferred status, the high class individuals had lower HI scores than the common peasant population. Finally, when both phase and status were considered, there appears to be no trend in HI score. This could be due to sample bias, but it is more likely that the weak association of HI score to known skeletal health is the cause. Passalacqua et al. (2011), using an identified sample of forensic skeletal cases with at least some known background, demonstrated that the HI found little correlation between HI score and known antemortem health status. Thus the HI may not be a reliable statistic in assessing relative health for individuals or populations. Many of the variables which contribute to the health index score, such as cribra orbitalia and the development of degenerative joint disease on the hands, deal with different processes; and the reduction of these multiple complex variables into a single rank-score may not be the best way to approach skeletal health. In addition, it should be noted that the HI did not function properly for two sites (Iglesia de Santa María de Villanueva and Iglesia de Santo Tomás de Riello) due to insufficient data available.

When the project sites were ranked by relative date, the HI score did appear to be lower ~1300 AD with San Pedro de Plecín (Phase I Late) and again with sites: San Juan (Phase II), San Julian De Viñon and San Pedro de Plecín (Phase II), all occurring ~1600 AD (see Figure 5 in

Results). While this could be interpreted as additional support for Hypothesis I, this association may also be spurious. There are no statistical outliers (in terms of standard deviation), but both phases of San Pedro de Plecín were ranked with the lowest HI scores in the sample. This may suggest something different is occurring at this specific site that is not purely related to overall changes in health over time. A visual examination of the output file suggests that this may be related to the amount of degenerative joint disease and shorter stature of these individuals, but with the nature of the HI algorithm unclear, this is only speculation.

Finally, all the project site HI scores are fairly high (mean = 87.1, on a scale of 0-100). This may be explained by the HI algorithm itself as it would appear that the lack of data has a positive effect on the final HI score. However this is unclear due to the statistical ambiguity of the algorithm. Passalacqua et al. (2011) did find similar results using all HI site scores from North America dated 1000 years BP to present, falling between 70-90 (n=40) (data from Steckel et al. 2002). This trend is also found in the full European dataset presented by Steckel et al. (2009), however here the HI scores largely fall between 60-80 (n=121). Further comparisons are currently unable to be made using the GHHP dataset from Western Europe as these data are unavailable until publication by the project authors. Even so, the lack of dispersion in the relative rank scores even from large datasets (along with the minimal correlation to known health status), suggests that the method is failing to provide meaningful scores in terms of ranking health or segregating sites based on skeletal health markers.

Project Limitations, Accomplishments, and Recommendations for Future Research

In order to draw accurate conclusions from bioarchaeological samples, the cemetery must be "typical" of the population it came from (Waldron 1991: 24). Thus the questions must always be asked (Hoppa 1996): Are these individuals typical of those that died in this population? Do their life histories reflect typical individuals from these populations?

There is no reason that the ~325 individuals recovered from these seemingly common mortuary contexts within Asturias would not be typical of the populations of which they are assumed to be derived. Nor is there reason to believe that their life histories would not accurately reflect those of their medieval contemporaries. However, due to the poor preservation of these samples and the overall incomplete documentation of their archaeological context, it is possible that bias exists within the present sample. Only with additional remains and future research can these conclusions be more heavily supported.

The issues of poor skeletal preservation and contextual information were the main limiting factors to this project. This combination tends to result in these skeletal collections being ignored, as was the case with much of this material. However, the statistical approach taken here, using a maximum likelihood method that can accept missing data, allowed for these collections to be systematically investigated for hypothesis testing. Further, it would appear that the regional approach to historical bioarchaeology may be a good model for future investigations with collections from similar contexts. The historic bioarchaeology approach allows for hypotheses based on the historical narrative to be tested using the bioarchaeological record, and the regional model allows for many small collections to be aggregated under the assumption that they come from similar (homogeneous) populations. Thus small, poorly documented or preserved collections can be used to generate significant conclusions by expanding the scale of analysis and examining larger historical questions.

The regional approach itself does have some drawbacks as it potentially loses precision when dealing with intra-site variation, which may be important at the local (site by site) scale. However, the exploratory latent class analysis was specifically performed in order to investigate possible site outliers or other meaningful clusters of individuals, and may be thought of as a failsafe. Because no meaningful clusters of individuals were found (excluding those very unhealthy individuals which fell into LC1) this supports the idea that these multiple cemetery populations likely make up a single homogeneous regional population.

In terms of future research, isotopic analysis for markers of diet and migration should be investigated. Currently, a pilot project using a reduced number of samples (n=62) from seven sites from the included skeletal collections is in progress by Amy Mackinnon under the supervision of Dr. Eric Bartelink (CSU Chico). In terms of diet reconstruction, these data may be able to shed additional light on the issue of differential access to nutrition in terms of sex or status. However, these data have the potential not only to demonstrate the amount of variation in the diet of these Medieval sites, but also to inform us of how much migration may have actually occurred during the Medieval period in Asturias.

The further investigation of secular changes in height and other variables could lead to interesting results. Stature records are available from the region of Castile-Leon dating back to at least 1830 AD (Lázaro and Carrión 2009) and other stature data may be found in bioarchaeological publications from other regions in Spain. Finally, biological distance from cranial shape may be an interesting topic that could potentially relate to issues of migration and homogeneity and an extension of this project to surrounding regions such as Galicia could not only support these conclusions, but allow for greater potential in competency of future discussions of life in Medieval Spain.

Final Interpretations

These rural village skeletal samples inform our understanding of life in Medieval Asturias, Spain in unique ways which were not previously understood or investigated. From these results it should be clear that the historical narrative often tells a different story than the bioarchaeological narrative. While historians (e.g. Kamen 1991; Lynch 1992; Ortiz 1971; Ruiz 2007) suggest rampant collapse and crisis throughout much of the later Medieval and Spanish Empire periods, the biology of the individuals from the same time shows no record of significant increases in stress or disease. Many other scholars (e.g. Bennett 2005; Miller 2003; Lopez et al. 2012) suggest the patriarchal nature of Medieval and Imperial Spain resulted in negative health outcomes for females in comparison to their male counterparts, but this is again not detected in the present examination of the skeletal biology. Finally, historians (e.g. Bango Toviso 1992) and mortuary anthropologists (e.g. Naji 2005; Ivison 1993; Effros 1997) alike argue that the practice of *ad sanctos* burial favored those high status individuals who were most regarded in the community, for prestigious burial locations within churches, but these results found no significant differences in terms of mortality (risk of dying at younger ages) or the development of physiological stress markers.

In terms of the statistical methods developed for this project, these models appear to have been successful and appropriate for further investigation for bioarchaeological applications. While the statistical analyses failed to identify significant differences between the various dependant and independent variables, it is unlikely that this would be due to the failure of the statistical models. More likely there were no differences between sexes, status, or time periods, or these differences were too minor to be detected with the present methods and variables due to the robust nature of the data. Further support for this conclusion is based on the findings of the exploratory latent class analyses which also did not detect meaning clusters of individuals as well as the health index data, which presented no significant outliers.

To conclude, this project has demonstrated that a historical bioarchaeological approach to the investigation of human skeletal remains can inform our interpretations of the historical record. While historical sources suggest periods of famine and crisis occurred in the late Medieval period of Spain, they may have had little effect on the peasant population of Asturias. Similarly, differences between male and female Asturian individuals do not appear to be reflected in a significant way via skeletal biology. Finally, while *ad sanctos* burial was practiced throughout Medieval Spain, the discrepancies between social burial status and biological health appear to be minimal in the Asturian samples. Only through future investigations on additional skeletal materials and the refinement of our methods can shed additional light on these conclusions.

APPENDICES

Appendix 1

Table 19. Appendix 1 Data Codes

Variable	*Code in Database*
ID	Individual identification number (note, ID numbers may contain gaps due to sites or individuals excluded from final project)
1. Site	1. San Salvador De Valdedios 2. San Salvador De Cornellana 3. Casco Historico de Villaviciosa Rehabbilitacion 4. San Miguel de Lino 5. Catedral de Oviedo 6. San Pedro de Plecin 7. San Juan 8. Iglesia de Santa Maria de Villanueva 9. San Julian de Vinon 10. San Pedro de Nora 11. Iglesia de Santo Tomas de Riello 12 18. Ermita de San Lorenzo de Cortina
2. Site Phase	1. Phase I Early 2. Phase I Late 3. Phase II
3. Site Status	1. Common 2. High
4. Sex	1. Female 2. Probable female 3 Male 4 Probable male 5 Subadult, sex indeterminant 6 Adult sex indeterminant
5. Age	. = likely adult with no other age markers present Otherwise mean age presented in years
6. Linear enamel hypoplasia in anterior dentition	0. Not observable (no suitable teeth, incomplete development, or too worn, etc.) 1. No hypoplasia present 2. One hypoplasia present 3. Two or more hypoplasia present
7. Cribra Orbitalia	0. Not observable 1. At least one orbit present with no observed porosity 2. A cluster of mostly fine foramina covering a small area, present on at least one orbit 3. Coalescing pores with orbital roof thickening present on at least one orbit

Table 19. Appendix 1 Data Codes. Con't

8. Cribra Orbitalia lesion activity	0. Not observable 1. Active (woven) at the time of death 2. Healed (sclerotic) 3. Mixed active and healed present
9. Porotic Hyperostosis	0. Not observable 1. At least one partial parietal present with no observed porosity 2. Porosity only present on at least one parietal 3. Coalescing pores with vault expansion present on at least one parietal
10. Porotic hyperostosis lesion activity	0. Not observable 1. Active (woven) at the time of death 2. Healed (sclerotic) 3. Mixed active and healed present
11. Tibial periostitis	0. No tibia(e) present for scoring 1. No infectious lesions of the tibia(e) present with at least one tibia available for observation 2. “Slight” Small discrete patch(s) of periosteal reaction involving less than one quarter of the tibia(e) surface on one or both tibiae 3. “Moderate” Periosteal reaction involving less than one-half of the tibia(e) surface on one or both tibiae 4. “Severe” Periosteal reaction involving more than one-half of the tibia(e) surface (osteomyelitis is scored here).
12. Tibial periostitis lesion activity	0. Not observable 1. Active (woven) at the time of death 2. Healed (sclerotic) 3. Mixed active and healed present
13. Other infections	0. No periosteal reaction on any other bone than the tibiae 1. Periosteal reaction on any other bone(s) than the tibiae 2. Evidence of systemic infection involving any of the bones (including the tibiae) of the skeleton.
14. Other infections lesion activity	0. Not observable 1. Active (woven) at the time of death 2. Healed (sclerotic) 3. Mixed active and healed present
15. Estimated Adult stature	Adult stature estimate in cm

Table 20. Nonmetric Skeletal Data.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	2	1	1	1	79	0	1	0	1	0	0	0	0	0	0
2	2	1	1	4	.	0	0	0	1	0	0	0	0	0	0
3	2	1	1	3	80	0	1	0	1	0	0	0	0	0	0
4	2	1	1	2	30	0	1	0	1	0	0	0	0	0	0
5	2	1	1	1	67	0	1	0	1	0	1	0	0	0	0
6	2	1	1	6	6	0	1	0	0	0	0	0	0	0	0
7	1	1	1	3	73	1	1	0	1	0	0	0	0	0	178.05
8	1	1	1	1	27	1	2	2	1	0	1	0	0	0	163.58
9	1	1	1	3	48	1	1	0	1	0	1	0	0	0	154.43
10	1	1	1	3	.	0	0	0	0	0	1	0	0	0	167.39
30	1	1	1	1	53	1	1	0	1	0	0	0	0	0	164.85
31	1	1	1	1	30	0	0	0	1	0	1	0	0	0	160.27
39	1	1	1	1	55	0	1	0	1	0	1	0	0	0	167.13
40	1	1	1	3	51	0	0	0	1	0	1	0	0	0	165.61
41	1	1	1	1	.	0	0	0	0	0	0	0	0	0	161.54
51	1	1	1	3	60	0	0	0	0	0	1	0	0	0	179.83
52	1	1	1	3	40	1	1	0	0	0	1	0	0	0	172.47
53	1	1	1	1	.	0	0	0	0	0	1	0	0	0	179.83
54	3	2	1	1	40	0	0	0	0	0	0	0	0	0	166.62
55	3	2	1	5	8	2	0	0	0	0	0	0	0	0	0
56	3	2	1	6	90	0	0	0	1	0	0	0	0	0	0
57	3	2	1	5	10	1	0	0	0	0	0	0	0	0	0
58	3	2	1	3	.	0	0	0	1	0	0	0	0	0	0
59	3	2	1	5	4	0	0	0	0	0	0	0	0	0	0
60	3	2	1	5	8	0	0	0	0	0	0	0	0	0	0
61	3	2	1	3	.	0	0	0	0	0	1	0	0	0	0
62	3	2	1	6	.	0	0	0	0	0	0	0	0	0	0
63	3	2	1	6	.	0	0	0	0	0	0	0	0	0	0
64	3	2	1	1	45	0	0	0	1	0	1	0	0	0	0
65	3	2	1	1	52	0	0	0	1	0	0	0	0	0	0
66	3	2	1	5	9	1	0	0	0	0	0	0	0	0	0
67	3	2	1	1	50	0	0	0	0	0	1	0	0	0	0
68	3	2	1	5	9	0	0	0	0	0	1	0	0	0	0
69	3	2	1	1	53	0	1	0	1	0	0	0	0	0	0

Table 20. Nonmetric Skeletal Data. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
70	3	2	1	5	5	0	0	0	0	0	0	0	0	0	0
71	1	1	1	3	60	0	0	0	0	0	1	0	0	0	171.7
72	1	1	1	1	87	0	1	0	1	0	0	0	0	0	0
73	1	1	1	6	75	0	0	0	0	0	0	0	0	0	0
74	1	1	1	1	35	0	0	0	0	0	0	0	0	0	154.43
75	1	1	1	1	.	0	0	0	0	0	0	0	0	0	0
76	1	1	1	5	2.5	0	0	0	0	0	0	0	0	0	0
77	1	1	1	5	7	1	0	0	0	0	0	0	0	0	0
78	1	1	1	1	66	0	1	0	1	0	1	0	0	0	0
79	1	1	1	3	65	0	1	0	1	0	1	0	0	0	173.23
80	1	1	1	3	35	0	0	0	0	0	1	0	0	0	173.23
81	1	1	1	1	60	0	0	0	1	0	0	0	0	0	0
82	1	1	1	5	0.5	0	0	0	1	0	0	0	0	0	0
83	1	1	1	3	.	0	0	0	0	0	1	0	0	0	176.02
84	1	1	1	5	6.5	1	0	0	1	0	0	0	0	0	0
94	4	1	1	6	47	0	0	0	0	0	0	0	0	0	0
95	4	1	1	5	15	0	0	0	0	0	0	0	0	0	0
96	4	1	1	5	5	0	0	0	0	0	0	0	0	0	0
97	4	1	1	6	.	1	1	0	0	0	0	0	0	0	0
98	4	1	1	5	15.5	1	0	0	1	0	0	0	0	0	0
99	4	1	1	2	11	1	0	0	1	0	0	0	0	0	0
100	4	1	1	1	90	0	0	0	1	0	0	0	0	0	161.54
101	4	1	1	3	15	1	0	0	0	0	0	0	0	0	173.74
102	4	1	1	5	2.5	0	1	0	0	0	0	0	0	0	0
103	4	1	1	1	8	0	0	0	0	0	0	0	0	0	165.61
104	4	1	1	1	48	1	2	2	1	0	1	0	0	0	157.99
105	4	1	1	3	75	0	1	0	1	0	1	0	0	0	167.39
106	4	1	1	3	66	0	1	0	1	0	0	0	0	0	178.31
107	4	1	1	1	.	0	0	0	0	0	1	0	0	0	167.39
108	4	1	1	1	.	0	1	0	1	0	1	0	0	0	164.34
109	5	3	2	3	65	0	1	0	1	0	1	0	0	0	178.56
110	5	3	2	3	45	1	0	0	1	0	1	0	0	0	171.45
111	5	3	2	3	50	0	0	0	0	0	1	0	0	0	163.58
112	5	3	2	1	.	0	0	0	0	0	1	0	0	0	154.43
113	5	3	2	3	55	0	1	0	1	0	1	0	0	0	174.5
114	5	3	2	1	.	0	1	0	1	0	0	0	0	0	0

Table 20. Nonmetric Skeletal Data. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
115	5	3	2	3	17.5	1	0	0	1	0	1	0	0	0	172.21
116	5	3	2	3	57	0	1	0	1	0	0	0	1	1	165.61
117	5	3	2	1	.	0	0	0	0	0	1	0	0	0	158.75
161	6	2	2	3	66	1	0	0	0	0	0	0	0	0	0
162	6	3	2	1	1	0	0	0	0	0	0	0	0	0	0
163	6	2	2	6	.	0	0	0	0	0	0	0	0	0	0
164	6	2	2	3	45	0	0	0	1	0	0	0	0	0	0
165	6	2	2	6	90	0	0	0	0	0	0	0	0	0	0
166	6	2	2	5	9.5	3	1	0	1	0	1	0	0	0	0
167	6	2	2	1	.	0	0	0	0	0	0	0	0	0	0
168	6	3	2	3	90	0	1	0	1	0	0	0	0	0	0
169	6	2	2	1	90	0	0	0	1	0	0	0	0	0	151.38
170	6	2	2	3	90	0	1	0	1	0	1	0	0	0	171.45
171	6	2	2	3	25	0	1	0	1	0	1	0	0	0	164.08
172	6	2	2	6	.	0	0	0	0	0	0	0	0	0	0
173	6	2	2	3	76	0	0	0	0	0	1	0	0	0	0
174	6	2	2	3	9	0	0	0	0	0	1	0	0	0	0
175	6	2	2	3	50	0	0	0	0	0	0	0	0	0	170.43
176	6	2	2	1	.	0	0	0	0	0	0	0	0	0	0
177	6	2	2	6	.	0	0	0	0	0	0	0	0	0	0
178	6	2	2	6	.	0	0	0	0	0	0	0	0	0	0
179	6	3	2	1	.	0	1	0	1	0	0	0	0	0	169.16
180	6	3	2	3	.	0	1	0	1	0	0	0	0	0	0
181	6	3	2	5	7	0	0	0	1	0	1	0	0	0	0
182	6	3	2	5	0	0	0	0	0	0	1	0	0	0	0
183	6	3	2	5	0	0	0	0	0	0	1	0	0	0	0
184	6	2	2	3	35	1	1	0	1	0	0	0	0	0	171.96
185	6	2	2	3	31	1	1	0	1	0	1	0	0	0	156.97
186	6	2	2	5	0	0	0	0	0	0	0	0	0	0	0
187	4	1	1	6	80	0	1	0	1	0	0	0	0	0	0
188	4	1	1	6	30	1	0	0	0	0	0	0	0	0	0
189	4	1	1	5	2	0	0	0	0	0	0	0	0	0	0
206	6	3	2	1	80	0	0	0	0	0	1	0	0	0	163.32
207	6	3	2	5	6	0	0	0	0	0	0	0	0	0	0
208	6	2	2	3	.	0	0	0	0	0	0	0	0	0	166.88
209	6	2	2	3	47	1	1	0	1	0	0	0	2	1	172.97

Table 20. Nonmetric Skeletal Data. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
210	6	2	2	3	.	0	0	0	0	0	0	0	0	0	0
211	6	2	2	3	.	0	0	0	0	0	1	0	0	0	161.8
212	6	2	2	3	.	0	0	0	0	0	0	0	1	2	164.34
213	6	2	2	1	.	0	0	0	0	0	1	0	0	0	168.91
214	6	2	2	5	0	0	0	0	0	0	0	0	0	0	0
215	6	3	2	1	90	0	1	0	1	0	1	0	0	0	146.05
216	6	3	2	6	.	0	1	0	1	0	0	0	0	0	0
217	6	3	2	1	.	0	0	0	0	0	0	0	1	2	0
218	6	3	2	3	.	0	0	0	0	0	0	0	0	0	172.97
219	6	3	2	1	43	0	0	0	0	0	1	0	0	0	143.76
220	6	2	2	2	9	1	1	0	1	0	0	0	0	0	0
221	6	2	2	3	43	0	1	0	0	0	0	0	0	0	168.4
222	6	2	2	1	60	0	1	0	1	0	1	0	0	0	157.23
223	6	3	2	3	90	0	2	2	1	0	1	0	3	2	173.74
224	6	3	2	3	.	0	1	0	1	0	0	0	0	0	169.16
225	6	3	2	3	.	0	0	0	0	0	1	0	1	2	163.32
226	6	3	2	1	40	0	0	0	1	0	1	0	0	0	156.21
227	6	3	2	3	55	0	0	0	0	0	1	0	0	0	172.47
228	6	2	2	3	45	1	0	0	0	0	1	0	0	0	160.27
229	6	2	2	5	1.5	0	0	0	0	0	0	0	0	0	0
230	6	2	2	6	55	0	0	0	0	0	0	0	0	0	0
231	6	2	2	3	68	0	2	2	1	0	0	0	0	0	167.39
232	6	2	2	5	11	1	1	0	1	0	0	0	0	0	0
233	7	3	1	6	.	0	0	0	0	0	0	0	0	0	0
234	7	3	1	5	10.5	0	0	0	0	0	0	0	0	0	0
235	7	3	1	5	6.5	0	1	0	1	0	0	0	0	0	0
236	7	3	1	3	40	0	0	0	1	0	0	0	0	0	0
237	7	3	1	3	80	0	1	0	1	0	0	0	0	0	169.16
238	7	3	1	3	40	0	0	0	0	0	0	0	0	0	163.07
239	7	3	1	1	.	0	0	0	0	0	0	0	0	0	148.34
240	7	3	1	3	50	0	0	0	0	0	1	0	0	0	159.26
241	7	3	1	1	.	0	0	0	0	0	0	0	0	0	157.73
242	7	3	1	1	50	0	0	0	0	0	0	0	0	0	166.37
243	7	3	1	1	.	0	0	0	0	0	0	0	0	0	145.54
244	7	3	1	5	9	0	0	0	0	0	0	0	0	0	0
245	7	3	1	3	80	0	1	0	1	0	0	0	0	0	0

Table 20. Nonmetric Skeletal Data. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
246	7	3	1	5	10	1	0	0	0	0	0	0	0	0	0
247	7	3	1	3	33	0	0	0	0	0	0	0	0	0	166.37
248	7	3	1	3	15	0	0	0	0	0	1	0	0	0	170.18
249	7	3	1	3	60	0	0	0	0	0	0	0	0	0	175.51
250	7	3	1	3	.	0	0	0	0	0	1	0	0	0	165.61
251	7	3	1	3	.	0	0	0	0	0	1	0	0	0	166.12
252	7	3	1	3	40	0	0	0	0	0	1	0	0	0	162.31
253	7	3	1	5	8	0	0	0	1	0	0	0	0	0	0
254	7	3	1	6	90	0	0	0	0	0	0	0	0	0	0
255	7	3	1	2	12	0	0	0	1	0	1	0	0	0	0
256	7	3	1	5	7.5	0	0	0	1	0	1	0	0	0	0
257	7	3	1	5	11.5	1	1	0	1	0	1	0	0	0	0
258	7	3	1	1	69	1	2	2	1	0	1	0	0	0	170.69
259	7	3	1	1	12.5	1	0	0	1	0	1	0	0	0	163.32
260	7	3	1	5	8	0	0	0	0	0	0	0	0	0	0
261	8	1	2	3	.	0	0	0	0	0	1	0	0	0	174.5
262	8	1	2	3	.	0	0	0	0	0	1	0	0	0	165.35
263	8	1	2	3	.	0	0	0	0	0	1	0	0	0	162.31
264	8	1	2	1	.	0	0	0	0	0	1	0	0	0	154.18
265	8	1	2	3	.	0	1	0	1	0	1	0	0	0	162.56
266	8	1	2	5	5	0	0	0	0	0	0	0	0	0	0
267	6	3	2	5	0.5	0	0	0	0	0	1	0	0	0	0
268	6	3	2	3	19	1	1	0	1	0	0	0	0	0	0
269	6	3	2	6	.	0	0	0	0	0	0	0	0	0	0
270	7	3	1	1	6.5	0	1	0	1	0	1	0	0	0	164.85
271	7	3	1	6	90	0	0	0	1	0	0	0	0	0	0
272	7	3	1	1	45	0	0	0	1	0	1	0	0	0	160.02
273	7	3	1	5	1.5	0	0	0	0	0	0	0	0	0	0
274	7	3	1	5	1.5	0	0	0	0	0	0	0	0	0	0
275	7	3	1	1	20	1	0	0	1	0	0	0	1	1	0
276	7	3	1	1	90	0	0	0	0	0	1	0	0	0	153.92
277	7	3	1	1	27	1	0	0	0	0	2	3	3	3	165.35
278	7	3	1	3	25	0	0	0	0	0	0	0	0	0	0
279	7	3	1	5	7	0	0	0	0	0	0	0	0	0	0
280	7	3	1	1	90	0	0	0	1	0	0	0	0	0	175.77
284	7	3	1	5	8	0	0	0	0	0	0	0	0	0	0

Table 20. Nonmetric Skeletal Data. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
285	6	3	2	5	2.5	0	0	0	0	0	0	0	0	0	0
286	6	3	2	5	0	0	0	0	0	0	2	1	0	0	0
290	9	3	1	6	24.5	1	0	0	1	0	0	0	0	0	0
291	9	3	1	3	.	0	0	0	0	0	0	0	0	0	0
292	9	3	1	6	.	1	0	0	1	0	0	0	0	0	0
293	9	3	1	6	.	0	0	0	0	0	0	0	0	0	0
294	9	3	1	6	.	2	0	0	1	0	0	0	0	0	0
295	9	3	1	5	16	2	0	0	0	0	0	0	0	0	0
296	9	3	1	6	.	0	0	0	0	0	1	0	0	0	0
297	9	3	1	5	13	1	0	0	1	0	0	0	0	0	0
298	9	3	1	5	12	2	1	0	0	0	0	0	0	0	0
299	9	3	1	1	.	0	1	0	1	0	0	0	0	0	0
300	9	3	1	1	.	0	0	0	0	0	0	0	0	0	0
301	9	3	1	6	.	0	0	0	0	0	0	0	0	0	0
302	9	3	1	5	10	0	0	0	0	0	0	0	0	0	0
303	9	3	1	5	13	1	0	0	1	0	0	0	0	0	0
304	9	3	1	6	.	0	0	0	0	0	0	0	0	0	0
305	9	3	1	6	.	0	0	0	1	0	0	0	0	0	0
306	9	3	1	1	.	0	0	0	0	0	0	0	0	0	0
307	9	3	1	6	.	0	0	0	1	0	0	0	0	0	0
308	9	3	1	6	.	0	0	0	0	0	0	0	0	0	0
309	9	3	1	1	57	0	0	0	1	0	0	0	0	0	0
310	9	3	1	6	.	0	0	0	0	0	0	0	0	0	0
311	9	3	1	2	14	1	1	0	1	0	0	0	0	0	0
312	9	3	1	3	54	0	1	0	1	0	1	0	0	0	0
313	9	3	1	1	55	0	0	0	0	0	1	0	0	0	157.99
314	9	3	1	1	.	0	0	0	1	0	1	0	0	0	0
315	9	3	1	6	.	0	0	0	1	0	0	0	0	0	0
316	9	3	1	3	.	0	0	0	0	0	1	0	0	0	0
317	9	3	1	6	.	1	0	0	1	0	1	0	0	0	0
318	9	3	1	3	40	0	0	0	1	0	0	0	0	0	0
319	9	3	1	6	.	0	0	0	0	0	1	0	0	0	0
320	9	3	1	1	.	0	0	0	0	0	0	0	0	0	0
321	9	3	1	1	55	0	0	0	0	0	0	0	0	0	0
322	9	3	1	1	.	0	0	0	0	0	0	0	0	0	0
323	9	3	1	1	.	0	0	0	0	0	1	0	0	0	0

Table 20. Nonmetric Skeletal Data. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
324	9	3	1	5	10	1	0	0	0	0	0	0	0	0	0
325	9	3	1	1	.	0	0	0	0	0	0	0	0	0	0
326	9	3	2	1	70	1	1	0	1	0	1	0	0	0	0
327	9	3	1	6	.	0	0	0	1	0	0	0	0	0	0
328	9	3	1	6	.	0	0	0	0	0	1	0	0	0	0
329	9	3	1	6	.	0	1	0	1	0	0	0	0	0	0
330	9	3	1	3	.	0	0	0	1	0	0	0	0	0	0
331	9	3	1	3	.	0	0	0	1	0	1	0	0	0	0
332	9	3	1	6	50	0	2	2	1	0	0	0	0	0	0
333	9	3	1	1	20	0	0	0	1	0	0	0	0	0	0
334	9	3	1	1	.	0	0	0	0	0	0	0	0	0	168.4
335	9	3	1	6	.	0	0	0	1	0	0	0	0	0	0
336	9	3	1	6	50	0	0	0	0	0	1	0	0	0	0
337	9	3	1	1	27	0	0	0	0	0	1	0	0	0	161.04
338	9	3	1	3	.	0	0	0	0	0	0	0	0	0	0
339	9	3	1	1	48	1	1	0	1	0	2	2	0	0	159
340	9	3	1	1	.	0	0	0	0	0	1	0	0	0	162.81
341	9	3	1	1	.	0	0	0	0	0	1	0	0	0	163.58
342	9	3	1	1	90	0	0	0	1	0	1	0	0	0	156.97
343	9	3	1	1	40	0	0	0	0	0	0	0	0	0	0
344	9	3	2	3	61	1	1	0	1	0	1	0	0	0	177.8
345	9	3	1	1	.	0	0	0	1	0	1	0	0	0	161.8
346	9	3	1	6	.	0	0	0	0	0	0	0	0	0	0
347	9	3	1	5	10	1	0	0	1	0	0	0	0	0	0
348	9	3	1	1	74	1	0	0	1	0	0	0	0	0	0
349	9	3	1	1	.	0	1	0	1	0	1	0	0	0	0
350	9	3	1	3	.	0	0	0	0	0	1	0	0	0	162.31
351	9	3	1	2	20	0	0	0	0	0	1	0	0	0	0
352	9	3	1	3	60	1	0	0	0	0	1	0	0	0	169.93
353	9	3	1	1	90	0	1	0	1	0	1	0	0	0	170.18
354	9	3	1	6	.	0	0	0	0	0	0	0	0	0	0
355	9	3	1	1	.	0	2	2	0	0	1	0	0	0	162.56
356	9	3	1	3	26	1	0	0	0	0	1	0	0	0	0
357	9	3	1	3	10	0	0	0	1	0	0	0	0	0	0
358	9	3	1	6	.	0	0	0	1	0	0	0	0	0	0
359	9	3	1	3	26	0	1	0	1	0	1	0	0	0	0

Table 20. Nonmetric Skeletal Data. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
360	9	3	1	3	50	0	1	0	1	0	1	0	0	0	175.26
361	9	3	1	1	.	0	0	0	1	0	1	0	0	0	0
362	9	3	1	3	.	0	0	0	0	0	1	0	0	0	0
363	9	3	1	3	50	0	0	0	1	0	1	0	0	0	143.26
364	9	3	1	6	.	0	0	0	1	0	0	0	0	0	0
365	9	3	1	3	32	1	1	0	1	0	1	0	0	0	166.12
366	9	3	1	3	87	0	1	0	1	0	1	0	0	0	168.91
367	9	3	1	3	63	1	1	0	1	0	0	0	0	0	163.83
368	9	3	1	1	90	0	1	0	1	0	0	0	0	0	0
369	9	3	1	6	.	0	1	0	0	0	0	0	0	0	0
370	10	1	1	3	90	0	0	0	1	0	0	0	0	0	175.77
371	10	1	1	1	10	1	0	0	0	0	0	0	0	0	166.62
372	10	1	1	1	.	0	0	0	0	0	0	0	0	0	160.02
373	10	1	1	1	.	0	2	2	1	0	0	0	0	0	0
374	10	1	1	3	.	0	0	0	0	0	0	0	0	0	166.37
375	10	1	1	5	10	1	0	0	0	0	0	0	0	0	0
376	10	1	1	1	20	0	0	0	0	0	0	0	0	0	163.32
377	10	1	1	1	.	0	0	0	0	0	1	0	0	0	0
378	10	1	1	3	90	0	0	0	0	0	0	0	0	0	163.58
379	10	1	1	1	20	0	1	0	1	0	0	0	0	0	0
380	10	1	1	3	30	1	0	0	0	0	1	0	0	0	0
381	10	1	1	6	.	0	0	0	0	0	0	0	0	0	0
382	10	1	1	6	18	1	0	0	0	0	0	0	0	0	0
383	10	1	1	1	90	0	1	0	0	0	0	0	0	0	0
384	10	1	1	1	90	0	1	0	0	0	1	0	0	0	157.48
385	10	1	1	1	12	1	0	0	0	0	1	0	0	0	162.56
386	10	1	1	1	.	0	0	0	0	0	0	0	0	0	163.32
387	10	1	1	1	.	0	0	0	0	0	1	0	0	0	156.97
388	10	1	1	1	.	0	0	0	0	0	1	0	0	0	163.83
389	10	1	1	3	50	0	1	0	1	0	1	0	0	0	154.69
390	10	1	1	3	40	1	1	0	1	0	1	0	0	0	160.78
391	10	1	1	1	15	0	2	2	1	0	0	0	0	0	0
392	10	1	1	1	60	0	0	0	0	0	1	0	0	0	152.91
393	10	1	1	1	40	0	0	0	0	0	1	0	0	0	148.84
394	10	1	1	6	.	0	0	0	0	0	1	0	0	0	154.18
395	10	1	1	1	40	0	0	0	0	0	1	0	0	0	161.04

Table 20. Nonmetric Skeletal Data. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
396	11	2	2	3	.	0	0	0	0	0	1	0	0	0	0
397	11	2	2	6	.	0	2	1	1	0	0	0	0	0	0
398	11	2	2	6	.	0	0	0	0	0	1	0	0	0	0
399	11	2	2	1	.	0	0	0	0	0	1	0	0	0	0
400	11	2	2	5	10	0	0	0	0	0	0	0	0	0	0
401	11	2	2	6	.	0	0	0	0	0	1	0	0	0	0
402	11	2	2	6	.	0	0	0	0	0	1	0	0	0	0
403	11	2	2	6	.	0	0	0	1	0	0	0	0	0	0
404	11	2	2	6	.	0	2	1	1	0	0	0	0	0	0
405	11	2	2	6	.	0	2	1	1	0	0	0	0	0	0
406	11	2	2	4	76	0	0	0	0	0	0	0	0	0	0
407	11	2	2	3	35	0	1	0	1	0	1	0	0	0	0
408	18	2	1	4	20	1	0	0	1	0	0	0	0	0	0
409	18	2	1	1	47	0	1	0	1	0	0	0	0	0	0
410	18	2	1	6	.	0	0	0	0	0	0	0	0	0	0
411	18	2	1	6	55	0	0	0	1	0	0	0	0	0	0
412	18	2	1	1	30	1	1	0	1	0	0	0	0	0	0
413	6	3	2	3	.	0	1	0	1	0	0	0	0	0	166.88
414	7	3	1	3	26	0	0	0	1	0	0	0	0	0	175.26
415	7	3	1	3	.	0	0	0	0	0	1	0	0	0	172.97
416	7	3	1	1	20	2	1	0	1	0	0	0	3	3	0
417	7	3	1	6	.	0	0	0	0	0	0	0	0	0	0
418	7	3	1	3	80	0	1	0	1	0	1	0	1	1	174.24
419	7	3	1	3	.	0	0	0	0	0	1	0	0	0	172.97
420	7	3	1	3	18	1	2	2	1	0	1	0	0	0	158.5
421	1	1	1	6	.	0	0	0	1	0	0	0	0	0	0
422	1	1	1	3	.	0	0	0	0	0	1	0	0	0	0
423	4	1	1	1	52	1	1	0	1	0	0	0	0	0	158.5
424	4	1	1	6	.	0	1	0	1	0	0	0	0	0	0
425	4	1	1	3	53	0	1	0	1	0	0	0	0	0	0
462	4	1	1	1	.	0	0	0	0	0	0	0	0	0	154.94
463	9	3	1	3	33	1	0	0	0	0	0	0	0	0	0
464	9	3	1	6	90	0	0	0	0	0	0	0	0	0	0
465	9	3	1	6	90	0	0	0	0	0	0	0	0	0	0
466	9	3	1	6	90	0	0	0	0	0	0	0	0	0	0
467	8	1	2	6	90	0	0	0	0	0	0	0	0	0	0

Table 20. Nonmetric Skeletal Data. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
468	6	3	2	4	30	0	0	0	0	0	0	0	0	0	0

Appendix 2

Table 21. Appendix 2 Data Codes.

Variable	*Measurement* all measurements are presented in mm. "." = measurement not available. Measurement names are given using the codes from the Forensic Data Bank and Fordisc when available, other measurement names given as described.
ID	Individual identification number (note, ID numbers may contain gaps due to sites or individuals excluded from final project)
1	Scapular Glenoid Width
2	HUMEBR-L
3	HUMEBR_R
4	HUMHDD_L
5	HUMHDD_R
6	HUMMXD_L
7	HUMMXD_R
8	HUMMWD_L
9	HUMMWD_R
10	HUMCIRM
11	Radial Head Diameter
12	Radial Distal Breadth
13	ULNCIR_L
14	ULNCIR_R
15	FEMEBR_L
16	FEMEBR_R
17	FEMHDD_L
18	FEMHDD_R
19	FEMSAP_L
20	FEMSAP_R
21	FEMSTV_L
22	FEMSTV_R
23	FEMSUBCIR
24	FEMMAP_L
25	FEMMAP_R
26	FEMMTV_L
27	FEMMTV_R
28	FEMCIR_L
29	FEMCIR_R
30	Patellar Maximum Length
31	Patellar Maximum Breadth

Table 21. Appendix 2 Data Codes. Con't.

32	TIBPEB_L
33	TIBPEB_R
34	TIBDEB_L
35	TIBDEB_R
36	TIBNFX_L
37	TIBNFX_R
38	TIBNFT_L
39	TIBNFT_R
40	TIBCIR_L
41	TIBCIR_R
42	CALCXL_L
43	CALCXL_R
44	CALCBR_L
45	CALCBR_R
46	GOL
47	XCB
48	BBH
49	BNL
50	AUB
51	Biasterionic Breadth
52	UFHT
53	WFB
54	FRC
55	PAC
56	OCC
57	FOL
58	FOB
59	MDH
60	TMF
61	GOG
62	CDL
63	WRB
64	XRB

Table 22. Osteometric measurements (1-25) present by individual.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
5	.	.	.	.	.	20	.	15	.	55	.	.	.	.	.	.	.	.	31	31	30	35	110	27	29
6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7	31	66	.	49	.	23	24	19	20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
8	.	55	56	43	.	20	21	14	14	.	21	30	.	.	76	.	47	46	27	.	29	.	.	28	.
9	29	62	64	.	45	21	23	17	19	62	22	32	39	38	.	82	.	46	27	27	33	30	105	28	28
10	.	.	.	.	.	.	.	.	.	.	.	29	.	.	73	73	45	.	30	.	31	.	.	27	.
30	.	58	58	39	.	21	21	16	.	.	.	.	.	.	.	.	40	.	25	.	28	.	91	.	.
31	.	.	.	.	.	.	.	.	.	.	.	29	35	.	72	72	42	.	27	28	29	31	91	27	27
39	.	59	60	.	45	.	21	.	17	65	22	31	.	.	.	.	46	47	25	25	31	33	.	27	.
40	30	67	.	45	.	24	.	21	.	.	25	31	.	.	.	73	48	45	30	29	33	35	105	.	26
41	.	.	57	.	.	21	.	15	.	.	.	29	35	.	.	.	43	.	25	27	30	30	88	26	27
51	.	66	67	49	49	22	.	19	.	67	24	34	.	.	.	.	.	49	.	.	.	.	.	33	.
52	30	67	65	48	49	23	25	18	18	.	24	33	.	.	82	77	48	48	27	28	34	35	105	.	33
53	.	.	.	.	.	.	.	.	.	.	.	.	32	.	74	.	40	.	28	.	31	.	92	25	.
54	.	.	.	.	.	21	.	15	.	.	.	.	.	.	.	.	44	.	25	.	33	.	98	27	.
55	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
56	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
57	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
58	.	.	.	43	.	21	.	19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	31	.
59	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
60	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 22. Osteometric measurements present by individual. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
61	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	34	.
62	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
63	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
64	.	.	.	43	.	18	.	.	.	.	.	.	.	.	.	.	.	.	26	.	31	.	95	27	28
65	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
66	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
67	.	.	.	.	.	.	19	.	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
68	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
69	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	40	24	23	30	30	85	29	28
70	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
71	.	63	63	.	.	22	22	17	17	75	25	.	.	.	.	83	47	48	27	28	35	34	98	29	.
72	.	.	.	.	.	21	.	17	.	.	.	.	.	.	.	.	.	44	.	.	.	.	.	.	.
73	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
74	.	.	.	.	.	.	.	.	.	.	21	30	.	.	.	.	.	.	.	.	.	.	.	.	.
75	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
76	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
77	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
78	.	.	.	.	.	.	.	.	.	.	20	.	.	33	.	.	.	43	.	27	.	31	.	27	.
79	34	67	66	.	51	21	23	18	18	67	25	34	.	.	.	.	55	54	33	.	33	.	106	31	.
80	.	.	.	.	.	.	.	.	.	.	25	31	.	.	.	.	50	.	34	.	34	.	110	34	.
81	.	.	.	44	.	21	.	17	.	.	21	.	.	.	.	.	.	.	.	.	.	.	.	.	.
82	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
83	.	.	66	.	.	.	23	.	.	.	.	.	.	.	.	.	.	49	.	31	.	35	101	34	.
84	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
94	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 22. Osteometric measurements present by individual. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
95	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
96	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
97	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
98	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
99	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
100	26	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
101	28	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
102	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
103	.	.	.	.	.	.	.	.	.	.	21	.	.	40	.	.	.	.	.	.	.	.	.	.	.
104	22	51	51	.	37	.	21	.	16	62	20	27	.	.	65	66	40	40	24	22	29	32	103	24	24
105	30	70	66	.	.	26	26	25	22	81	28	35	40	.	80	.	.	48	30	.	32	.	100	29	31
106	31	68	70	50	50	24	25	20	18	73	26	36	.	.	.	.	52	51	31	31	36	39	107	.	31
107	.	.	.	.	37	.	20	.	15	60	.	30	.	39	.	.	42	.	24	.	30	.	86	.	.
108	.	.	.	40	.	24	.	22	.	72	22	.	.	.	.	.	.	.	.	.	.	.	.	.	26
109	30	66	.	.	48	25	.	20	.	75	.	.	.	.	80	80	48	48	30	32	36	35	110	34	35
110	26	61	.	44	44	23	20	20	16	60	24	.	38	.	.	.	46	.	29	.	29	.	100	33	.
111	.	.	68	.	48	.	.	.	.	.	23	30	37	.	82	.	47	.	29	.	33	.	125	31	.
112	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	70	39	.	24	.	31	.	90	29	28
113	30	.	.	45	.	25	25	22	23	75	.	31	.	.	.	.	48	49	30	30	32	32	108	33	34
114	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
115	26	61	64	47	47	.	27	.	21	77	24	31	40	.	.	46	46	.	31	31	34	33	.	30	31
116	.	.	.	63	.	29	.	25	.	88	.	.	.	.	85	.	50	.	34	.	36	.	120	32	.
117	.	.	56	44	.	22	25	18	20	74	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
161	.	.	.	.	.	.	.	.	.	.	24	.	.	.	.	.	.	.	.	.	.	.	.	26	.
162	.	.	.	.	.	.	21	.	18	64	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 22. Osteometric measurements present by individual. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
163	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
164	.	.	.	.	.	21	.	18	.	62	.	.	.	.	.	.	44	.	.	26	.	32	95	30	30
165	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
166	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
167	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	68	.	.	.	.	.	.	.	.	.
168	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
169	24	.	.	.	40	.	18	.	11	58	21	.	.	.	.	.	.	.	.	.	.	.	.	.	.
170	.	67	.	.	.	.	25	.	19	73	26	33	.	.	.	.	53	.	.	31	.	38	108	34	.
171	.	.	.	37	.	21	.	17	.	.	.	.	40	.	.	.	42	44	.	29	.	31	96	.	.
172	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
173	.	.	65	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	37	.
174	.	.	.	.	.	21	.	18	.	66	.	.	.	.	.	.	45	.	30	.	34	.	107	.	.
175	.	.	.	.	.	.	.	.	.	.	.	.	43	.	.	.	.	.	.	.	.	.	.	.	.
176	.	.	57	.	.	.	22	.	19	67	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
177	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
178	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
179	26	.	.	42	.	20	.	16	.	58	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
180	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	31	.	34	.	105	35	.
181	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
182	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
183	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
184	30	.	.	.	.	.	.	.	.	.	26	35	.	.	.	.	.	.	.	.	.	.	.	.	.
185	.	59	.	41	41	22	22	17	17	69	.	29	.	.	.	.	.	.	.	29	.	33	97	.	28
186	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
187	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 22. Osteometric measurements present by individual. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
188	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
189	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
206	26	58	59	.	.	22	.	17	.	63	22	.	.	.	.	78	45	45	27	28	32	34	100	26	26
207	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
208	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
209	29	63	66	47	48	24	25	22	20	75	24	33	.	.	.	.	.	.	.	.	.	.	.	.	.
210	.	.	.	.	.	24	.	18	.	68	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
211	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
212	.	.	.	.	.	.	.	.	.	.	24	35	36	.	.	.	.	47	.	.	.	.	.	31	.
213	.	.	.	.	.	.	.	.	.	.	.	34	.	.	.	.	.	46	.	28	.	31	101	.	31
214	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
215	23	50	50	39	.	19	.	14	.	53	.	29	33	.	75	72	42	42	28	25	27	28	95	24	29
216	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
217	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28	.
218	31	.	59	.	47	.	24	.	22	70	.	.	44	.	.	.	.	.	.	.	.	.	.	.	.
219	.	.	.	.	.	.	.	.	.	.	24	33	.	.	70	72	39	40	25	26	32	31	94	26	26
220	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
221	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
222	25	51	52	.	.	19	20	16	16	56	20	29	32	.	.	.	39	39	23	23	26	28	86	27	27
223	.	.	58	.	.	.	23	.	17	.	24	32	.	.	.	76	46	46	29	28	36	36	108	31	32
224	32	.	.	47	48	29	24	20	20	73	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
225	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
226	.	56	57	.	.	21	.	11	.	62	.	.	.	.	.	75	41	41	30	26	32	33	97	28	28
227	29	62	61	.	48	24	24	20	21	75	26	33	39	41	76	.	49	.	28	28	32	32	97	31	31
228	29	62	63	45	45	22	24	19	19	70	24	32	40	.	80	81	45	45	27	28	31	31	94	32	32

Table 22. Osteometric measurements present by individual. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
229	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
230	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
231	29	62	63	47	48	21	22	19	18	67	.	30	.	33	.	.	.	.	.	.	.	.	.	.	.
232	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
233	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
234	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
235	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
236	.	.	.	.	.	.	.	.	.	.	.	33	43	.	.	.	.	47	.	30	.	32	95	.	28
237	31	.	.	.	50	24	26	19	20	71	.	35	.	41	.	.	49	.	29	.	32	.	.	.	.
238	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	73	.	.	.	30	.	36	97	.	27
239	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	70	.	39	.	24	.	29	82	25	.
240	.	.	.	.	.	.	.	.	.	.	.	34	40	43	.	.	48	50	.	30	.	34	101	.	29
241	.	.	.	.	.	.	26	.	24	73	25	.	.	.	74	.	.	42	24	.	28	.	85	24	25
242	25	.	56	.	41	19	20	17	18	61	23	32	.	.	.	.	.	.	.	.	.	.	.	.	.
243	.	.	.	.	.	.	.	.	.	.	18	30	.	.	.	.	.	.	.	.	.	.	.	.	.
244	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
245	.	.	.	.	.	23	.	20	.	68	22	.	.	.	.	.	51	.	.	.	.	.	.	35	.
246	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
247	.	66	68	.	48	22	22	19	19	70	.	.	.	.	.	.	50	50	29	30	36	36	104	27	.
248	.	.	.	.	.	.	.	.	.	.	25	.	.	.	.	.	.	.	.	.	.	.	.	.	.
249	.	.	66	.	49	.	26	.	20	77	.	.	.	.	.	84	.	51	.	28	.	33	103	.	28
250	.	.	.	.	.	.	.	.	.	.	.	.	.	.	76	.	46	.	31	.	32	.	100	29	.
251	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
252	.	.	.	.	.	.	.	.	.	.	.	.	.	.	80	.	46	47	29	30	34	33	102	31	.
253	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 22. Osteometric measurements present by individual. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
254	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
255	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
256	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
257	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
259	24	.	.	.	.	.	.	.	.	.	22	.	.	.	.	73	.	42	.	.	.	.	.	.	25
260	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
261	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
262	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	82	.	.	.	.	.	.	.	.	29
263	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
264	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
265	.	.	.	.	.	21	.	17	.	.	.	.	.	.	.	75	43	44	.	29	.	37	.	.	30
266	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
267	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
268	.	.	.	.	.	.	49	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
269	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
270	27	.	42	.	.	23	.	19	.	67	.	.	.	.	76	.	45	.	26	27	35	34	100	27	29
271	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
272	25	58	58	.	43	.	23	.	18	67	20	29	.	34	.	.	45	44	.	27	.	31	92	.	29
273	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
274	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
275	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	39	.	.	.	.	.	.	.	.
276	.	54	53	.	.	.	.	.	.	.	.	29	37	.	.	73	.	45	.	27	.	32	101	.	27
277	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	49	.	30	.	34	.	97	28	.
278	.	.	.	.	.	21	.	18	.	64	.	.	34	.	.	.	.	.	.	.	.	.	.	.	.
279	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 22. Osteometric measurements present by individual. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
280	.	.	.	48	.	25	.	22	.	75	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
284	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
285	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
285	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
286	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
290	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
291	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	26	.
292	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
293	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
294	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
295	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
296	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
297	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
298	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
299	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
300	.	.	.	.	.	23	.	16	.	65	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
301	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
302	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
303	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
304	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
305	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
306	.	60	.	.	.	21	.	18	.	59	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
307	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
308	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
309	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 22. Osteometric measurements present by individual. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
310	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
311	.	.	.	.	.	23	.	18	.	68	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
312	.	63	.	46	.	21	.	16	.	62	.	.	.	.	.	.	47	.	29	.	35	.	102	31	.
313	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	43	.	.	25	.	30	.	.	28
314	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
315	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
316	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
317	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
318	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
319	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
320	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28	.
321	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
322	.	.	.	.	.	.	.	.	.	.	.	29	.	.	.	.	.	.	.	.	34	.	.	27	.
323	.	.	.	.	.	.	.	.	.	.	.	28	.	.	.	.	.	.	.	.	.	.	.	.	.
324	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
325	.	.	.	.	.	22	.	20	.	67	.	.	.	.	.	.	.	.	.	.	.	.	.	23	.
326	.	.	.	.	.	22	.	18	.	66	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
327	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
328	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
329	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
330	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	49	.	.	.	.	.	.	29	.
331	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	31	.
332	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
333	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	22
334	27	57	.	.	.	25	.	19	.	70	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 22. Osteometric measurements present by individual. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
335	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
336	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
337	.	.	.	.	.	.	.	.	.	.	24	.	.	.	.	.	.	.	27	.	30	.	89	29	.
338	.	.	.	.	.	25	.	21	.	75	23	.	.	.	.	.	.	.	.	.	.	.	.	.	30
339	.	.	.	.	.	20	.	15	.	70	.	30	.	.	.	.	.	.	25	.	31	.	88	25	.
340	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	43	.	29	.	34	.	94	26	.
341	.	.	.	.	44	20	22	18	19	64	.	.	.	.	.	.	47	.	25	26	33	33	94	26	27
342	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	72	.	.	.	.	.	.	.	.	.
343	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	24	.
344	34	.	.	.	50	.	29	.	23	81	25	37	.	.	.	.	.	.	32	.	37	.	110	33	.
345	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	75	42	43	.	26	.	31	.	27	28
346	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
347	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
348	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	30	.
349	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	30	.
350	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	80	.	49	.	31	.	38	105	.	33
351	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
352	32	.	.	.	.	.	.	.	.	.	.	37	.	.	.	82	.	51	28	.	36	.	100	32	.
353	.	63	.	49	.	22	.	19	.	62	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
354	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
355	.	58	58	.	44	21	21	15	15	58	22	31	.	.	75	.	44	46	25	25	33	32	90	28	29
356	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
357	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
358	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
359	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 22. Osteometric measurements present by individual. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
360	.	69	68	.	.	.	.	.	.	.	23	.	.	.	.	78	51	50	.	31	.	39	112	31	33
361	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	27	.
362	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	35	35
363	.	.	.	.	.	.	.	.	.	.	.	31	.	40	79	.	.	.	28	.	35	.	105	32	.
364	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
365	.	.	.	.	.	.	.	.	.	.	.	.	.	41	79	.	49	.	31	.	34	.	104	30	31
366	.	65	66	49	.	.	24	.	23	72	.	.	.	.	.	78	49	48	34	30	30	31	103	36	36
367	.	.	65	.	.	.	24	.	17	69	.	.	.	.	.	.	.	47	.	30	.	31	100	.	30
368	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	40	.	25	.	30	.	95	.	.
369	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
370	.	.	.	.	50	.	23	.	21	71	.	.	.	.	.	.	.	.	.	.	.	.	.	31	.
371	25	.	.	.	.	.	.	.	.	.	.	.	.	33	.	.	43	.	.	.	.	.	.	.	.
372	.	.	.	.	.	21	.	16	.	62	.	32	.	34	.	.	.	.	.	.	.	.	.	29	.
373	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
374	.	.	65	.	46	.	24	.	21	72	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
375	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
376	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	69	.	41	.	24	.	28	85	.	26
377	.	.	.	.	40	.	21	.	16	60	.	.	.	.	65	.	.	.	.	.	.	.	.	27	.
378	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	79	.	47	.	28	.	35	102	.	27
379	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
380	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
381	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
382	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
383	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
384	.	.	.	.	.	.	.	.	.	.	.	35	.	.	.	.	.	.	.	.	.	.	.	26	.

Table 22. Osteometric measurements present by individual. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
385	23	.	.	.	.	.	.	.	.	.	.	27	.	35	69	.	40	.	26	.	29	.	87	24	.
386	.	.	.	.	.	.	.	.	.	.	21	28	.	.	.	.	.	.	.	.	.	.	.	.	.
387	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
388	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	41	.	24	.	30	.	.	24
389	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	31	.	35	.	100	32	.
390	29	.	63	44	44	24	24	20	17	70	.	.	.	40	79	80	46	47	30	29	35	33	94	31	30
391	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
392	.	.	.	.	36	.	.	.	.	.	.	.	.	.	.	.	.	.	21	.	30	.	84	.	.
393	.	.	51	.	.	.	19	.	13	55	.	.	.	.	.	.	.	38	.	22	.	28	84	.	23
394	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
395	.	.	.	.	.	22	.	20	.	78	20	.	.	.	.	.	40	41	28	26	35	34	103	.	27
396	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
397	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
398	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
399	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	25	.	29	.	.	24
400	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
401	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
402	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
403	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
404	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
405	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
406	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
407	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	32	.
408	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
409	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	43	.	24	.	34	.	94	.	.

Table 22. Osteometric measurements present by individual. Con't.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
410	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
411	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
412	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	42	.	24	.	34	.	92	.	.
413	31	66	.	.	50	27	29	21	22	86	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
414	31	66	.	.	47	26	25	19	18	76	.	.	.	42	.	.	.	.	.	.	.	.	.	.	.
415	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	48	.	28	.	37	.	101	.	.
416	.	.	.	.	46	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
417	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
418	.	.	62	48	.	25	.	18	.	70	.	.	43	.	.	81	46	46	.	31	.	35	107	29	.
419	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	34	.
420	30	.	.	.	.	.	.	.	.	.	23	.	.	.	.	.	42	.	26	.	32	.	90	.	.
421	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
422	.	61	.	.	.	.	.	.	.	.	.	.	.	.	.	74	45	.	26	.	35	.	97	.	30
423	25	55	54	41	40	19	19	16	17	67	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
424	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
425	.	.	.	.	.	.	22	.	17	75	.	.	.	.	.	75	.	46	.	.	.	.	.	.	31
462	.	.	.	.	.	.	.	.	.	.	.	.	.	.	71	72	.	43	.	24	.	30	88	24	24
463	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	47	.	.	.	.	.	.	.	.
464	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
465	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
466	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
467	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
468	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 23. Osteometric measurements (26-45) present by individual.

ID	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
5	25	26	80	80	.	.	.	.	.	.	33	32	21	23	90	90	.	.	.	.
6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
8	23	.	.	.	39	42	70	70	.	.	31	.	21	.	.	.	.	.	.	.
9	28	28	.	.	.	.	71	80	50	50	31	35	25	25	.	.	77	.	45	.
10	26	.	.	.	42	40	.	.	44	.	33	.	24	.	.	.	82	85	.	44
30	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
31	26	27	92	85	41	43	66	66	42	48	32	34	20	23	90	.	.	71	.	.
39	26	.	.	.	.	38	.	.	.	.	.	.	.	.	.	.	.	.	.	.
40	.	26	.	.	.	.	.	66	.	42	.	34	.	23	.	.	.	.	.	.
41	26	25	.	81	.	.	66	.	.	.	33	.	22	.	.	.	.	.	.	.
51	29	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
52	.	27	.	94	46	.	76	.	48	49	39	38	23	24	.	.	87	87	42	42
53	25	.	81	.	38	40	68	67	43	44	31	31	20	20	82	.	66	65	38	38
54	27	.	83	.	.	.	.	.	.	.	35	33	23	23	.	.	.	.	.	41
55	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
56	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
57	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
58	25	.	.	90	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
59	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
60	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 23. Osteometric measurements (26-45) present by individual. Con't.

ID	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
61	27	.	96	.	.	.	.	.	.	.	35	.	26	.	.	.	.	.	.	.
62	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
63	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
64	24	23	89	80	.	.	.	.	.	.	32	.	20	.	85	.	.	.	.	.
65	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
66	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
67	.	.	.	.	39	.	.	.	.	.	.	27	.	20	.	.	.	.	38	.
68	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
69	27	25	85	88	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
70	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
71	29	.	95	.	.	.	.	77	.	.	.	33	.	21	.	.	.	.	.	.
72	.	.	.	.	37	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
73	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
74	.	.	.	.	36	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
75	.	.	.	.	32	40	.	.	.	.	.	.	.	.	.	.	.	.	.	.
76	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
77	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
78	27	.	.	.	.	.	.	.	39	.	32	.	21	.	85	.	.	.	.	.
79	30	.	95	.	41	45	.	.	51	56	34	34	23	23	.	.	82	.	44	.
80	27	.	100	.	40	43	80	.	52	51	36	38	27	25	98	.	83	.	47	.
81	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
82	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
83	27	.	95	.	.	.	.	.	.	.	.	35	.	23	.	92	.	79	.	44
84	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 23. Osteometric measurements (26-45) present by individual. Con't.

ID	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
94	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
95	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
96	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
97	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
98	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
99	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	66	.	39	.
101	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	76	.	41	.
102	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
103	.	.	.	.	41	40	.	.	.	.	.	.	.	.	.	.	.	.	.	.
104	25	24	86	86	.	.	61	62	39	40	27	28	22	23	86	80	73	.	34	.
105	27	28	90	.	.	.	.	.	50	48	.	.	.	.	.	.	81	82	45	44
106	.	26	.	92	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
107	.	.	.	.	37	36	66	.	.	.	27	.	21	.	.	.	72	72	39	38
108	.	24	81	.	.	.	.	.	47	.	36	.	23	.	.	.	75	75	38	38
109	30	29	101	.	.	.	.	78	.	43	.	42	.	30	.	114	.	.	.	.
110	28	.	95	.	43	46	.	75	48	50	.	35	.	27	.	98	.	.	.	.
111	29	.	95	.	43	46	76	.	51	51	37	36	26	25	97	92	79	.	48	.
112	24	24	84	85	.	.	60	.	.	.	32	31	23	23	85	86	.	.	.	.
113	29	28	97	100	.	.	.	72	53	.	37	38	25	24	100	.	.	88	.	45
114	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
115	27	29	.	.	.	.	.	80	.	52	.	40	.	32	.	105	80	80	42	41
116	28	.	95	.	40	45	.	.	44	.	35	.	27	.	97	.	.	.	.	.
117	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
161	27	.	85	.	.	46	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 23. Osteometric measurements (26-45) present by individual. Con't.

ID	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
162	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
163	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
164	27	26	90	90	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
165	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
166	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
167	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
168	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
169	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
170	28	.	93	.	.	.	.	.	.	.	37	.	23	.	100	.	82	.	.	.
171	.	.	.	.	.	.	.	.	68	.	30	.	24	.	97	.	.	.	.	.
172	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
173	28	.	101	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
174	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
175	.	.	.	.	46	48	.	.	.	.	.	.	.	.	.	.	.	81	.	46
176	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
177	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
178	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
179	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
180	28	.	102	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
181	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
182	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
183	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
184	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
185	.	26	88	.	41	42	.	.	.	.	37	.	26	.	.	100	.	.	.	.
186	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 23. Osteometric measurements (26-45) present by individual. Con't.

ID	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
187	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
188	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
189	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
206	29	28	86	85	45	42	.	74	49	50	35	35	21	22	90	90	78	.	40	.
207	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
208	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	83	84	47	47
209	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
210	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
211	.	.	.	.	46	47	74	76	49	51	34	36	20	21	95	93	82	80	45	.
212	28	.	92	.	.	.	.	.	.	.	.	.	.	.	.	.	75	.	46	.
213	.	25	88	.	42	.	.	.	.	.	.	.	.	.	.	.	.	65	.	36
214	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
215	25	30	77	.	39	40	66	.	.	.	28	26	21	19	80	.	.	.	.	.
216	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
217	27	.	86	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
218	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
219	27	26	83	82	43	44	66	67	44	44	31	32	20	20	82	86	65	68	39	39
220	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
221	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	79	.	44	.
222	23	23	80	80	36	37	65	.	40	40	28	29	20	19	75	76	64	65	41	41
223	30	28	97	95	41	49	.	70	.	46	.	.	.	.	.	91	.	.	.	.
224	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
225	.	.	.	.	.	.	.	.	55	.	32	.	25	.	.	.	82	.	45	.
226	26	26	86	85	39	42	.	67	.	.	34	34	24	24	88	90	.	.	.	.
227	26	25	90	90	45	49	73	.	51	.	35	35	23	25	92	90	81	82	42	41

Table 23. Osteometric measurements (26-45) present by individual. Con't.

ID	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
228	26	26	92	92	.	50	75	76	52	50	37	36	26	25	109	110	79	79	41	42
229	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
230	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
231	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
232	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
233	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
234	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
235	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
236	.	28	.	88	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
237	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
238	.	27	.	87	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
239	23	.	.	78	37	42	.	66	.	47	.	30	.	20	.	80	.	66	.	38
240	.	27	.	94	41	45	77	.	.	.	33	35	25	26	93	94	.	.	.	.
241	26	26	78	.	44	46	.	.	.	.	.	.	.	.	.	.	.	.	.	.
242	.	.	.	.	35	38	.	.	.	.	.	.	.	.	.	.	71	.	40	.
243	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
244	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
245	26	.	95	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
246	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
247	26	.	84	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
248	.	.	.	.	.	.	.	77	.	54	.	34	.	26	.	96	.	.	.	.
249	.	29	.	90	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
250	27	.	87	.	.	.	79	.	53	.	34	.	25	.	95	.	.	.	.	.
251	.	.	.	.	.	.	73	.	50	.	34	.	24	.	95	.	.	.	.	.
252	28	.	92	.	.	.	.	75	.	47	.	34	.	24	.	93	.	76	.	41

Table 23. Osteometric measurements (26-45) present by individual. Con't.

ID	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
253	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
254	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
255	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
256	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
257	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
258	.	26	.	84	.	.	71	71	.	.	31	31	24	25	.	.	78	77	.	43
259	.	25	.	80	.	.	.	70	.	.	.	.	.	.	.	.	.	.	.	.
260	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
261	.	.	.	.	.	.	.	.	51	53	.	41	.	30	.	110	.	85	.	48
262	.	27	.	91	48	47	.	.	.	.	.	32	.	25	.	91	.	.	.	.
263	.	.	.	.	.	.	75	.	50	.	.	.	.	.	.	.	.	72	.	43
264	.	.	.	.	.	.	72	.	47	.	29	.	22	.	91	.	.	.	.	.
265	.	28	.	.	41	42	.	.	.	.	37	38	21	22	94	94	.	.	.	.
266	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
267	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
268	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
269	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
270	24	27	.	90	.	.	.	72	48	48	30	32	21	22	93	83	76	75	40	41
271	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
272	.	25	.	86	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
273	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
274	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
275	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
276	.	26	.	80	41	40	.	.	43	.	.	.	.	.	.	.	.	65	.	40
277	28	.	90	.	.	.	.	.	.	.	.	.	.	.	.	.	.	76	.	.

Table 23. Osteometric measurements (26-45) present by individual. Con't.

ID	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
278	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
279	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
280	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
284	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
285	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
286	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
290	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
291	28	.	.	77	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
292	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
293	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
294	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
295	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
296	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
297	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
298	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
299	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
301	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
302	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
303	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
304	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
305	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
306	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
307	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
308	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 23. Osteometric measurements (26-45) present by individual. Con't.

ID	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
309	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
310	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
311	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
312	27	.	91	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
313	.	24	.	83	41	44	.	70	.	.	.	30	.	22	.	80	71	.	39	.
314	.	.	.	.	36	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
315	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
316	.	.	.	.	.	.	.	.	.	.	32	.	26	.	93	.	.	.	.	.
317	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
318	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
319	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
320	24	.	84	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
321	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
322	20	.	76	.	.	.	.	.	.	.	.	28	.	22	80	.	.	.	.	.
323	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
324	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
325	18	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
326	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
327	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
328	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
329	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
330	29	.	92	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
331	25	.	89	.	.	.	.	.	.	.	.	34	.	25	.	94	.	.	.	.
332	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
333	.	22	.	77	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 23. Osteometric measurements (26-45) present by individual. Con't.

ID	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
334	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
335	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
336	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
337	25	.	85	.	.	.	.	71	.	57	.	34	.	23	.	88	.	.	.	.
338	.	27	.	90	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
339	26	.	80	.	.	.	.	.	.	.	.	31	.	20	.	82	.	.	.	.
340	29	.	88	.	.	.	.	68	42	.	31	33	21	21	85	85	.	.	.	.
341	26	27	85	85	.	.	.	.	.	.	34	.	24	.	94	.	.	71	.	.
342	.	.	.	.	.	.	.	71	43	.	33	32	20	19	85	81	75	75	38	40
343	23	.	77	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
344	31	.	103	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
345	25	25	80	.	.	.	66	.	45	.	33	.	19	.	85	.	.	.	.	.
346	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
347	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
348	24	.	84	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
349	26	.	90	.	.	.	.	46	.	.	35	.	22	.	91	.	.	.	.	.
350	.	27	95	.	.	.	78	76	.	.	38	37	28	27	106	97	.	.	.	.
351	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
352	28	.	94	.	.	.	.	.	80	.	39	.	24	.	101	.	84	80	46	47
353	.	.	.	.	.	.	.	.	.	.	.	34	.	23	.	94	.	.	.	.
354	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
355	25	25	83	.	40	40	71	.	.	.	32	31	20	20	81	84	74	73	44	46
356	.	.	.	.	43	46	.	.	.	.	.	.	.	.	.	.	.	.	.	.
357	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
358	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 23. Osteometric measurements (26-45) present by individual. Con't.

ID	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
359	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
360	29	29	95	100	.	.	.	.	.	60	.	42	.	25	107	.	90	88	.	46
361	26	.	.	.	.	.	.	.	.	.	35	.	23	.	93	.	.	.	.	.
362	29	29	101	97	.	.	.	.	.	.	41	.	29	.	112	.	.	.	.	.
363	28	.	93	.	.	.	74	74	50	49	36	36	23	24	95	96	.	81	.	39
364	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
365	29	27	93	90	.	.	76	.	50	.	36	35	29	30	105	107	.	79	.	47
366	29	29	102	102	42	48	.	76	.	.	.	40	.	25	101	.	.	.	.	.
367	.	28	.	91	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
368	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
369	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
370	27	.	94	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
371	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	79	.	39	.
372	25	.	87	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
373	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
374	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
375	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
376	.	22	.	74	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
377	26	.	.	82	40	38	66	.	.	.	31	.	19	.	77	.	.	.	.	.
378	.	28	.	89	.	.	.	.	.	.	.	.	.	.	.	.	78	77	40	40
379	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
380	.	.	.	.	.	.	.	.	.	.	.	36	.	23	.	98	.	.	.	.
381	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
382	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
383	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 23. Osteometric measurements (26-45) present by individual. Con't.

ID	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
384	27	.	84	.	.	46	.	71	.	45	.	31	.	23	.	85	.	.	.	.
385	23	.	75	.	.	.	66	.	.	.	31	.	21	.	85	.	.	.	.	.
386	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
387	.	.	.	.	40	39	71	.	49	.	30	.	21	.	82	.	.	.	.	.
388	.	24	.	.	.	.	.	.	.	48	31	32	21	21	81	82	.	.	.	.
389	28	.	93	.	.	.	.	.	.	.	.	32	.	23	.	90	.	.	.	.
390	29	28	90	93	41	43	74	73	50	50	37	38	24	26	97	97	.	83	.	42
391	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
392	.	.	.	.	.	37	.	.	.	.	28	.	19	.	75	.	.	.	.	.
393	.	23	.	73	37	37	.	.	43	.	.	29	.	20	77	.	66	.	34	35
394	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
395	.	28	.	85	40	43	.	.	42	.	31	.	23	.	87	.	78	79	38	38
396	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
397	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
398	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
399	.	26	.	77	.	.	.	.	.	.	32	.	22	.	85	.	.	.	.	.
400	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
401	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
402	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
403	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
404	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
405	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
406	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
407	27	.	92	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
408	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 23. Osteometric measurements (26-45) present by individual. Con't.

ID	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
409	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
410	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
411	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
412	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
413	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
414	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
415	.	.	.	.	.	.	.	.	.	.	35	.	28	.	105	.	.	80	.	48
416	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
417	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
418	29	.	.	90	.	.	.	.	45	.	32	.	24	.	.	.	84	.	.	.
419	29	.	99	.	.	.	.	.	48	.	37	.	24	.	95	.	85	84	40	.
420	.	.	.	.	.	.	74	.	.	.	.	.	.	.	.	.	.	.	.	.
421	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
422	.	28	.	90	.	.	75	.	.	.	33	.	25	.	90	.	.	.	.	.
423	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
424	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
425	.	29	.	95	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
462	24	23	74	75	.	.	.	65	.	.	.	27	.	21	.	80	.	.	.	.
463	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
464	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
465	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
466	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
467	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
468	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 24. Osteometric measurements (46-64) present by individual.

ID	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
1	.	.	.	.	117	116	.	97	.	.	.	.	.	23	10	110	.	32	.
2	.	.	.	.	.	.	.	.	.	.	.	.	.	27	.	.	.	.	.
3	188	138	.	.	130	100	67	97	113	110	95	.	.	28	.	.	.	.	.
4	.	140	.	.	.	.	.	.	112	117	.	.	.	26	.	.	.	.	.
5	189	138	.	.	.	.	.	.	.	121	100	.	.	24	.	.	.	.	.
6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7	.	.	.	.	.	101	.	.	.	118	.	.	.	29	15	104	.	35	45
8	195	142	143	103	121	95	.	98	118	121	103	40	31	23	13	90	.	31	40
9	.	.	.	.	.	112	.	102	118	120	.	.	.	28	15	.	.	30	43
10	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	29	.
30	187	140	135	99	120	110	56	96	109	123	102	34	.	24	10	94	114	31	46
31	.	.	.	.	.	105	.	.	.	.	92	35	31	28	.	.	.	.	.
39	.	.	.	.	.	.	.	95	102	114	.	.	.	27	.	.	.	.	.
40	198	136	.	.	.	.	.	.	.	.	.	.	.	30	.	104	.	27	47
41	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
51	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
52	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	109	133	33	50
53	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
54	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
55	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
56	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
57	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
58	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
59	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 24. Osteometric measurements (46-64) present by individual. Con't.

ID	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
60	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
61	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
62	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
63	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
64	.	.	.	.	.	.	.	.	.	114	.	.	.	33	.	.	.	.	.
65	.	.	.	.	.	.	.	.	.	.	.	.	.	20	.	.	.	.	.
66	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
67	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
68	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
69	190	.	.	.	.	.	.	.	.	113	.	.	.	28	.	.	.	.	.
70	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
71	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
72	.	.	.	.	.	.	.	99	.	.	.	.	.	.	.	.	.	.	.
73	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
74	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
75	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
76	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
77	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
78	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	105	.	30	.
79	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	26	.
80	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
81	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
82	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
83	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
84	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 24. Osteometric measurements (46-64) present by individual. Con't.

ID	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
94	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
95	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
96	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
97	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
98	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
99	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	27	.
100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	29	42
101	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
102	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
103	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
104	178	134	131	105	119	109	72	95	110	114	97	36	30	22	12	95	117	32	47
105	195	140	146	117	124	115	66	99	120	99	122	34	29	36	13	95	124	33	48
106	.	.	.	.	.	.	.	100	112	120	.	.	.	30	.	.	.	.	42
107	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
108	.	.	.	.	.	.	.	.	.	.	.	.	.	28	.	.	.	30	46
109	.	.	.	.	.	.	.	102	.	118	.	.	.	.	13	.	.	39	50
110	.	.	.	.	.	.	.	.	.	.	.	.	.	36	.	.	.	.	.
111	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
112	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
113	200	142	.	.	.	.	.	107	113	122	95	.	.	33	.	.	.	31	.
114	180	.	.	.	.	.	.	97	114	110	92	.	.	28	.	.	.	.	.
115	.	.	.	.	.	.	.	.	.	.	.	.	.	.	16	.	.	35	.
116	199	.	.	.	.	.	.	.	.	.	.	.	.	.	15	.	.	.	37
117	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
161	.	.	.	.	.	.	.	.	.	.	.	.	.	30	.	.	.	29	44

Table 24. Osteometric measurements (46-64) present by individual. Con't.

ID	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
162	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
163	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
164	.	.	.	.	.	.	.	.	.	.	.	.	.	25	.	.	.	.	.
165	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
166	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
167	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
168	177	148	134	104	127	111	.	99	112	104	106	35	32	27	.	111	132	29	45
169	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	27	.
170	.	.	.	.	.	.	.	97	.	.	.	.	.	.	.	.	.	.	.
171	.	.	.	.	.	.	.	97	.	.	.	.	.	.	.	.	.	33	46
172	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
173	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
174	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
175	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
176	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
177	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
178	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
179	.	.	.	.	.	.	.	95	.	.	.	.	.	.	.	.	.	.	.
180	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
181	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
182	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
183	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
184	176	151	131	99	125	115	.	.	113	103	95	36	31	32	.	107	.	30	42
185	.	.	.	.	131	.	.	105	.	.	.	.	.	28	14	102	114	32	50
186	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 24. Osteometric measurements (46-64) present by individual. Con't.

ID	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
187	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
188	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
189	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
206	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
207	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
208	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
209	181	144	.	.	124	114	.	100	114	119	93	.	.	.	14	109	.	30	.
210	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
211	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
212	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
213	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
214	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
215	.	.	.	.	.	.	.	.	.	115	.	.	28	.	.	90	109	21	36
216	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
217	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
218	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
219	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
220	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	26	.
221	.	.	.	.	.	.	.	.	.	.	.	.	.	24	.	.	.	30	.
222	.	.	.	.	.	.	.	.	.	.	.	.	.	27	.	.	.	.	.
223	.	.	.	.	.	.	.	.	115	.	.	.	.	.	.	.	.	.	.
224	.	.	.	.	.	.	.	.	.	.	.	.	.	26	.	99	.	31	.
225	.	.	.	.	.	.	.	.	.	.	.	.	.	35	.	.	.	.	.
226	.	.	.	.	.	.	.	.	.	.	.	.	.	24	.	.	.	.	.
227	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 24. Osteometric measurements (46-64) present by individual. Con't.

ID	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
228	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15	106	134	30	43
229	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
230	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
231	175	156	135	102	.	119	.	.	112	113	96	36	32	27	.	97	.	27	.
232	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
233	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
234	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
235	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
236	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
237	.	.	.	104	.	.	.	101	120	116	.	.	.	.	.	94	126	31	49
238	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
239	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
240	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
241	190	146	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
242	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
243	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
244	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
245	.	.	.	.	.	.	.	.	.	.	.	.	.	33	.	.	.	.	.
246	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
247	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	102	123	32	.
248	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
249	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
250	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
251	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
252	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 24. Osteometric measurements (46-64) present by individual. Con't.

ID	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
253	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
254	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
255	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28	.
256	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
257	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
258	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	103	.	.	26
259	.	.	.	.	.	.	.	.	.	.	.	.	.	29	10	.	.	31	40
260	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
261	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
262	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
263	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
264	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
265	.	.	.	.	.	.	.	.	.	.	.	.	.	25	.	.	.	.	.
266	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
267	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
268	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12	110	.	31	46
269	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
270	.	.	.	.	.	.	.	98	.	.	.	.	.	.	.	.	.	28	.
271	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
272	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13	94	.	.	.
273	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
274	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
275	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
276	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	31	.
277	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13	99	.	.	.

Table 24. Osteometric measurements (46-64) present by individual. Con't.

ID	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
278	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
279	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
280	.	145	.	.	.	110	.	.	.	114	104	36	33	.	.	.	.	.	.
284	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
285	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
286	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
290	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
291	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
292	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
293	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
294	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
295	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
296	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
297	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
298	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
299	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
301	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
302	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
303	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
304	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
305	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
306	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
307	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
308	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 24. Osteometric measurements (46-64) present by individual. Con't.

ID	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
309	.	.	.	.	.	.	.	.	.	.	.	.	.	25	.	.	.	27	.
310	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
311	.	.	.	.	.	.	.	.	.	.	.	.	.	29	.	.	.	.	.
312	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
313	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
314	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
315	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
316	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
317	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
318	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15	99	.	31	42
319	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
320	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
321	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10	.	.	.	.
322	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
323	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
324	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
325	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
326	.	.	.	.	.	.	.	.	.	.	.	.	.	30	10	.	.	.	.
327	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
328	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
329	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
330	.	.	.	.	.	.	.	.	.	.	.	.	.	25	.	.	.	.	.
331	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
332	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
333	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 24. Osteometric measurements (46-64) present by individual. Con't.

ID	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
334	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
335	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
336	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
337	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
338	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
339	.	.	.	.	.	.	.	.	.	.	.	.	.	24	.	.	.	30	.
340	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
341	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
342	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
343	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
344	186	135	.	.	125	116	.	.	109	114	97	.	30	30	12	115	.	34	46
345	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
346	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
347	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
348	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11	99	122	31	42
349	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
350	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
351	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28	.
352	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
353	.	.	.	.	.	.	.	.	.	.	.	.	.	26	.	.	.	27	40
354	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
355	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
356	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
357	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
358	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 24. Osteometric measurements (46-64) present by individual. Con't.

ID	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
359	.	.	.	.	.	.	.	104	114	.	.	.	.	26	12	105	.	29	.
360	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
361	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
362	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
363	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	34	.
364	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
365	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
366	.	.	.	.	.	.	.	.	.	.	.	.	.	28	.	109	113	31	43
367	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
368	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
369	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
370	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12	.	.	.	.
371	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
372	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
373	176	.	137	.	.	.	.	96	113	109	.	31	25	21	.	.	.	.	.
374	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
375	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
376	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
377	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
378	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
379	181	137	.	.	.	.	.	94	108	109	.	34	25	26	.	.	.	.	.
380	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
381	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
382	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
383	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	21	.

Table 24. Osteometric measurements (46-64) present by individual. Con't.

ID	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
384	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
385	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
386	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
387	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
388	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
389	.	.	.	.	.	.	.	.	.	.	.	.	.	24	.	.	.	.	.
390	.	.	.	.	.	.	.	100	115	.	.	.	.	30	10	108	.	.	.
391	.	.	.	.	.	.	.	.	103	.	.	.	.	.	.	.	.	29	.
392	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	88	.	24	.
393	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
394	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
395	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
396	.	.	.	.	.	.	.	100	.	.	.	.	.	.	.	.	.	.	.
397	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
398	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
399	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
400	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
401	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
402	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
403	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
404	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
405	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
406	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	.
407	.	.	.	.	.	.	.	96	113	.	.	.	.	.	.	.	.	.	.
408	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	30	.

Table 24. Osteometric measurements (46-64) present by individual. Con't.

ID	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
409	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
410	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
411	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
412	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28	.
413	.	.	.	.	.	.	.	.	.	.	.	.	.	32	12	121	.	31	46
414	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
415	M	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
416	.	.	.	.	.	.	.	97	.	.	.	.	28	26	12	98	124	35	49
417	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
418	.	.	.	.	.	.	.	.	.	.	.	.	.	31	.	.	.	.	.
419	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
420	.	.	.	.	.	.	.	.	.	.	.	.	.	33	16	115	125	34	46
421	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
422	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
423	177	138	128	96	119	107	61	95	107	110	97	34	29	25	.	88	111	29	41
424	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
425	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
462	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
463	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	31	40
464	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
465	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
466	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
467	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
468	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13	98	.	32	.

References

References

Acsádi GY, Nemeskéri J (1970). History of human lifespan and mortality. Akademiai Kaido, Budapest.

Adán Alvarez G (1995). San Salvador / San Pedro de Plecin (Alles). Actuacion arqueologica y sintesis historica. In: Excavaciones Arqueologicas en Asturias 1991-1994, Granada, Servicio Publicaciones: 308-317.

Adán Alvarez G (1999). Intervencion arqueologica en Santo Tomás de Riello, Teverga. 1998. In: Excavaciones Arqueologicas en Asturias 1995-1998, Granada, Servicio Publicaciones: 285-286.

Adán Alvarez G, Martinez Faedo L, Diaz Garcia F (1997). San Pedro de Nora: Evolucion constructive y restauraciones. In: Hevia Blanco J (editor) La intervencion en la arquitectura prerromanica Asturiana. Gijon, Universidad de Oviedo:161-182.

Álvarez Fernándo M, Soledad Beltran Suarez M, Calleja Puerta M, Pilar Garcia Cuentos M, Ruiz de la Pena Gonzalez I, Ignacio Ruiz de la Pena Solar J, Josepha Sanz Fuentes M, Sanchez E, Gonzalez A (2009). Vivir en la Asturias medieval. Asturias, Pintar-Pintar Comunicación.

Anderson T (2004). Dental treatment in Medieval England. British Dental Journal 197:419-425.

Armelagos GJ (2003). Bioarchaeology as anthropology. Archeological Papers of the American Anthropological Association 13:27-40.

Armelagos GJ (1969). Disease in ancient Nubia. Science 163:255-259.

Andrushko VA (2007). The Bioarchaeology of Inca Imperialism in the Heartland: An Analysis of Prehistoric Burials from the Cuzco Region of Peru. PhD Dissertation. University of California, Santa Barbra, CA.

Aufderheide A, Rodríguez-Martín C (1998). The Cambridge encyclopedia of human paleopathology. Cambridge: Cambridge University Press.

Bango Toviso IG (1992). El espacio para enterramientos privilegiados en la arquitectura medieval Espanola. Anuario del Departamento de Historia y Teoria del Arte. IV:93-132.

Baxter MJ (1994). Exploratory multivariate analysis in archaeology. Edinburgh, Edinburgh University Press.

Beaver DC (1998). Parish communities and religious conflict in the Vale of Gloucester, 1590-1690. Harvard, Harvard University Press.

Benedictow OJ (2004). The Black Death 1346-1353: The complete history. Great Britain, Cromwell Press.

Beneitez Gonzalez C, Villa Vlades Á. Intervencion arqueologica en la iglesia de Santa Maria de Villanueva (Teverga, Asturias) (2003). In: Excavaciones Arqueologicas en Asturias 1999-2002 Jorge Camino Mayor (editor). Granada, Servicio Publicaciones :357-.364.

Bennett JM (2005). Medieval women in modern perspective. In: History a global perspective. Smith BG (editor). Urbana, University of Illinois Press:139-186.

Berrizbeitia EL (1989). Sex Determination with the Head of the Radius. Journal of Forensic Science 34(5):1206-13.

Bruand D (1998). Cohors: The governor and his entourage in the self image of the Roman republic. In: Cultural identity in the Roman Empire. Laurence R, Berry J (editors). London, Routledge pp:10-24.

Bosch M, Bozzoli C, Quintana-Domeque C (2009). Infant mortality, adult income and adult stature in Spain. Economía de la Salud y Hábitos de Vida FEDEA – "la Caixa"

Bowes K, Kulikowski M (2005). Hispania in Late Antiquity. Leiden, Brill.

Brickley M, Ives R (2006). Skeletal manifestations of infantile scurvy. American Journal of Physical Anthropology 129:163-172.

Buikstra JE (2006). Preface. In: JE Buikstra and LA Beck (editors). Bioarchaeology: the contextual analysis of human remains. Amsterdam, Academic Press:xvii-xx.

Buikstra JE, Cook DC (1980). Paleopathology: An American account. Annual Review of Anthropology 9:433-470.

Buikstra JE, Ubelaker DH (1994). Standards for Data Collection from Human Skeletal Remains. Arkansas Archeological Survey Research Series No. 44, Fayetteville, AR.

Bush H, Zvelebil M (1991). Pathology and health in past societies: an introduction. In: Health and past societies: biocultural interpretations of human skeletal remains in archaeological contexts Bush H, Zvelebil M (editors). British Archaeological Reports, International Series 567, Oxford, Tempus Reparatum:3-10.

Cantera MJR (1987). El sepulcro en España en el siglo XVI. Madrid, Tipología e iconografía.

Carr KE (2005). Vandals to Visigoths: Rural settlement patterns in early medieval Spain. Ann Arbor, The University of Michigan Press.

Celeux G, Soromenho G (1996). An entropy criterion for assessing the number of clusters in a mixture model. Journal of Classification 13:195-212.

Chapman, R.W. (2005) “Mortuary analysis: A Matter of Time?” In: Interacting with the Dead: Perspectives on Mortuary Archaeology for the New Millennium. G. Rakita, J. Buikstra, L. Beck and S. Williams (editors). University Press of Florida. Gainesville. 293.

Charles D (2005). “The Archaeology of Death as Anthropology.” In: Interacting with the Dead: Perspectives on Mortuary Archaeology for the New Millennium. G. Rakita, J. Buikstra, L. Beck and S. Williams (editors). University Press of Florida. Gainesville.

Conant KJ (1978). Carolingian and Romanesque architecture, 800 to 1200. Hong Kong, Yale University Press.

Cook DC, Powell ML (2006). The evolution of American paleopathology. In: Bioarchaeology: The contextual analysis of human remains. Buikstra JE, Beck LA (editors). Amsterdam, Elsevier:281-322.

Collins R (1989). The Arab Conquest of Spain: 710-797. Cambridge, Basil Blackwell.

Collins R (2000). Visigothic Spain 409-711 AD. In: Spain, A History. R Carr (editor). Oxford, Oxford University Press:39-62.

Curchin LA (1991). Roman Spain: Conquest and assimilation. London, Routledge.

del Valle A, Romero M (2006). Cervantes: Father of Don Quixote and son of a dentist. Journal of Dental Research 85:701–704.

DeWitte SN. (2010). Sex differentials in frailty in Medieval England. American Journal of Physical Anthropology 143:285-297

Dickerman M (1979). Female infanticide, reproductive strategies, and social stratification: A preliminary model. In: Changnon N, Irons W (editors), Evolutionary Biology and Human Social Behavior. Massachusetts, Duxbury Press: 321-367

Dirkmaat DC, Cabo LL, Ousley SD, Symes SA (2008). New perspectives in forensic anthropology. Yearbook of Physical Anthropology 51:33-52

DiZerega G (2004). Pagans and Christians: the personal spiritual experience. St. Paul, Llewellyn Worldwide.

Dodgson JE, Sthruthers R (2005). Indigenous Women's Voices: Marginalization and health. Journal of Transcultural Nursing 16(4):339-346

Effros B (1997). Beyond cemetery walls: Early medieval funerary topography and Christian salvation. Early medieval Europe 6(1):1-23.

Effros B (2002). Caring for Body and Soul: Burial and the afterlife in the Merovingian world. Pennsylvania, The Pennsylvania State University Press.

Ferguson E (2003). Backgrounds of early Christianity. Grand Rapids, Wm. B. Eermans Publishing Co.

Fernández MA, Beltrán Suárez MS, Callaja Puerta M, Garcia Cuetos MP, Pena González IR, Peña Solar JIR, Sanz Fuentes MJ (2009). Vivir en la Asturias medieval. Oviedo, Pintar-Pintar Comunicación.

Fernandez AG (2003). Memoria del seguimiento arqueologico de la Rehabilitacion del Casco Historico de Villaviciosa (Tercera Fase - 2002). In: Jorge Camino Mayor (editor) Excavaciones Arqueologicas en Asturias 1999-2002, Granada, Servicio Publicaciones :395-.397.

Fernandez Conde FJ, Alonso Alonso GA (1992). Excavaciones en el yacimiento arqueologico de Valdedios (Villaviciosa). In: Excavaciones Arqueologicas en Asturias 1987-1990, Granada, Servicio Publicaciones: 171-178.

Galeria V (1989). La población medieval cántabra de Santa María de Hito: Aspectos paleodemográficos, morfológicos, paleopatológicos, paleoepidemiológiocos y de etnogénesis. PhD dissertation, Departamento de Biología Animal, Universidad de Alcalá, Spain

Garcia de Castro Valdes C (1995). Excavaciones arqueologicas en San Miguel de Lillo (Oviedo). Campaña de 1991. In: Excavaciones Arqueologicas en Asturias 1991-1994, Granada, Servicio Publicaciones: 127-136.

García de Castro Valdés C (2000). Catedral de San Salvador de Oviedo. Informe sobre las excavaciones arqueológicas llevadas a cabo en el edificio. Octubre 1998-mayo 1999.

García de Castro Valdés C (2002). Informe sobre las excavaciones arqueológicas realizadas en el solar N 3 de la calle Schulz (Antiguo Colegio San Isidoro) y en la misma calle Schulz de la ciudad de Oviedo (Febrero 2000-Abril 2001).

Geary PJ (1994). Living with the dead in the middle ages. Ithaca, Cornell University Press.

Gies F, Gies J (1978). Women in the middle ages. New York: Harper Collins Publishing Inc.

Gillett A (2006). Ethnogenesis: A contested model of early medieval Europe. History Compass 4(2):241-260.

Goldstein L (1981). One dimensional archaeology and multidimensional people: Spatial organization and mortuary analysis. In: Chapman R, Kinnes J, Randsborg K (editors). The Archaeology of death. Cambridge, Cambridge Press: 53-69.

Goldstein L (2006). Mortuary analysis and bioarchaeology. In: Bioarchaeology: The contextual analysis of human remains. Buikstra JE, Beck LA (eds.), Amsterdam, Elsevier:375-388.

Goodman A, Martin DL, Armelagos GJ, Clark G (1984). Indications of stress from bone and teeth. In Cohen N, Armelagos G, editors. Paleopathology at the origins of agriculture. Orlando: Academic Press. p 13-49.

Goodman AH, Brooke Thomas R, Swedlund AC, Armelagos GJ (1988). Biocultural perspectives on stress in prehistoric, historical and contemporary population research. Yearbook of Physical Anthropology 31:169-202.

Goodman AH (1991). Health, adaptation, and maladaptation in past societies. In: Bush H, Zvelebil M (editors.), Health and past societies: biocultural interpretations of human skeletal remains in archaeological contexts. British Archaeological Reports, International Series 567, Oxford, Tempus Reparatum:31-38

Grauer AL (1991). Patterns of life and death: the paleodemography of Medieval York. In: Bush H, Zvelebil M (editors.), Health and past societies: biocultural interpretations of human skeletal remains in archaeological contexts. British Archaeological Reports, International Series 567, Oxford, Tempus Reparatum:67-80.

Greene PJ (1992). Medieval Monasteries. New York; Continuum.

Hauschild T (1992). Informe preliminary sobre las excavatinoes en la iglesia de San Miguel de Liño. In: Excavaciones Arqueologicas en Asturias 1987-1990, Granada, Servicio Publicaciones: 193-200.

Heather P (2006). The fall of the Roman Empire: A new history of Rome and the barbarians. Oxford, Oxford University Press.

Henry-Claude M, Stefanon L, Zaballos Y (2001). Principles and Elements of Medieval Church Architecture of Western Europe. France, Fragile.

Hillson S (2002). Dental Anthropology. Cambridge, Cambridge University Press.

Hoppa RD (1996). Representativeness and bias in cemetery samples: implications for palaeodemographic reconstructions of past populations. PhD dissertation. Department of Anthropology, McMaster University.

Hoppa RD, Vaupel JW (2002). The Rostock Manifesto for paleodemography: The way from stage to age. In: Hoppa RD and Vaupel JW (editors). Paleodemography: Age distributions from skeletal samples. Cambridge: Cambridge University Press:1-8.

Insoll T (2001). The archaeology of Islam. In: Archaeology and world religion. Insoll T (editor). New York, Routledge pp 123-147.

Ivison EA (1993). Mortuary practices in Byzantium (c950-1453): An archaeological contribution. University of Birmingham. PhD Dissertation.

Jenny L (2011). A Bioarchaeological Study of Local Roman Identity: Skeletal Stress and Mortuary Treatment in the Butt Road Cemetery. PhD Dissertation. Michigan State University.

Johnson LJ (1972). Problems in "Avant-Garde" archaeology. American Anthropologist, 74(3):366-377

Kamen H (1991). Spain, 1469-1714: A society in conflict. London, Longman Group.

Kamen H (2003). Empire: How Spain became a world power: 1492-1763. New York, HarperCollins Publishers.

Keay S (1995). Innovation and adaptation: The contribution of Rome to Urbanism in Iberia. Proceedings of the British Academy 86:291-338.

Kemkes-Grottenthaler A (2005). The short die young: The interrelationship between stature and longevity- evidence form skeletal remains. American Journal of Physical Anthropology 128:340-347.

Kerr NW (1998). Dental pain and suffering prior to the advent of modern dentistry. British Dental Journal 184:397–399.

Komlos J, Baur M (2004). From the tallest to (one of) the fattest: the enigmatic fate of the American population in the 20th century. Economics and Human Biology 2:57-74.

Konigsberg LW, Frankenberg SR (2007). Paleodemography under duress: Growth and sexual dimorphism of the minimum femoral circumference. Paper presented at the American Association of Physical Anthropology 76th annual meeting:146

Kramer A, Konigsberg LW (1999). Recognizing species diversity among large-bodies hominoids: a simulation test using missing data finite mixture analysis. Journal of Human Evolution 36:409-421.

Kulikowski M (2004). Late Roman Spain and its cities. Baltimore, The Johns Hopkins University Press.

Landau PM, Steele DG (1996). Why anthropologists study human remains. American Indian Quarterly, 20(2):209-228.

Lane P (2001). The archaeology of Christianity in global perspective. In: Archaeology and world religion. Insoll T (editor). New York, Routledge:123-147.

Larsen CL (1997). Bioarchaeology: Interpreting behavior from the human skeleton. Cambridge University Press: Cambridge.

Laurence R (1998). Introduction. In: Cultural identity in the Roman Empire. Laurence R, Berry J (editors). London, Routledge:1-9.

Lázaro JM, Carrión JMM (2009). La evolucion de la estatura en una region atrasada de la Espana interior: Castilla y Leon, 1830-1960. Hispania: Revista Espanola de Historia. LXIX, 231:209-234.

Lewis ME (2007). The bioarchaeology of children: perspectives from biological and forensic anthropology. Cambridge, UK: Cambridge University Press.

Linehan P (1993). History and the historians of medieval Spain. Oxford, Oxford University Press.

Little RJA, Rubin DB (2002). Statistical analysis with missing data. Hoboken, Wiley-Interscience.

Lopez B, Pardiñas AF, Garcia-Vazquez E, Dopico E (2012). Socio-cultural factors in dental diseases in the medieval and early modern age of northern Spain. HOMO - Journal of comparative human biology. In press.

Lorrio AJ, Zapatero GR (2005). The Celts in Iberia: An overview. Journal of interdisciplinary Celtic studies. 6:167-254.

Lukacs JR (1992). Dental paleopathology and agricultural intensification in South Asia: New evidence from Bronze Age Harappa." American Journal of Physical Anthropology. 87(2):133-150.

Lynch J (1991). Spain 1516-1598: From nation state to World Empire. Oxford: Blackwell.

Mann RW, Murphy SP (1990). Regional atlas of bone disease: A guide to pathologic and normal variation in the human skeleton. Springfield, Charles C Thomas.

Marichal C (2007). Bankruptcy of Empire: Mexican silver and the wars between Spain, Britain, and France. Cambridge: Cambridge University Press.

Martinez Faedo L, Adan Alvarez G (1995). La Iglesia Prerromanica de S. Pedro de Nora (Las Regueras). In: Excavaciones Arqueologicas en Asturias 1991-1994, Granada, Servicio Publicaciones: 286-292.

Martinez Villa A, Cabo C, Requejo Pages O (1992). Noticia sobre los trabajos arqueologicos realizados en El Monasterio de San Salvador de Cornellana (Salas). In: Excavaciones Arqueologicas en Asturias 1987-1990, Granada, Servicio Publicaciones :253.

McCutcheon AL (1987). Latent Class Analysis (Sage University Paper series on Quantitative Applications in the Social Sciences, No. 07-064). Newbury Park, CA: Sage Publications Inc.

McLaughlin M (1994). Consorting with saints: Prayer for the dead in early Medieval France. Ithica, Cornell University Press.

Miller P (2003). Transformation of patriarchal regimes, literacy, and schooling. Interchange 34:297–312.

Milligan C (2010). Paleopathology and public health in "America's healthiest city": A comparative study of health from the Milwaukee country institution grounds cemetery. PhD Dissertation. Michigan State University, East Lansing, MI.

Muthén LK Muthén BO (2010). Mplus User's Guide. Sixth Edition. Los Angeles, CA: Muthén & Muthén

Naji S (2005). Death and remembrance in medieval France: A case study from the Augustinian monastery of Saint-Jean-des-Vignes, Soissons. In: Interacting with the Dead: Perspectives on Mortuary Archaeology for the New Millennium, Rakita G, Buikstra JE, Beck LA, Williams SR (editors) Gainesville, University Press of Florida:173-189.

Noymer A, Garenne M (2000). The 1918 influenza epidemic's effects on sex differentials in mortality in the United States. Population and Development Review 26:565–581.

Nylund KL, Asparouhov T, Muthen BO (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A monte carlo simulation study. Structural Equation Modeling 14(4):535-569.

O'Callahan JF (2003) Reconquest and crusade in Medieval Spain. Philadelphia, University of Philadelphia Press.

Ortiz AD (1971). The golden age of Spain: 1516-1659. New York; Basic Books Inc.

Ousterhout R (2008). Master builders of Byzantium. Philadelphia, University of Pennsylvania museum of archaeology and anthropology.

Ortner DJ, Kimmerle EH, Diez M (1999). Probable Evidence of Scurvy in Subadults from Archaeological Sites in Peru. American Journal of Physical Anthropology 108(3):321-331.

Ortner DJ (2003). Identification of pathological conditions of the human skeleton. San Diego, Academic Press.

Ousley S (1995). Should we estimate biological or forensic stature? Journal of Forensic Sciences 40(5): 768-773.

Passalacqua NV, Vollner JM, Semeraro DS, Rainwater CW (2011). A pilot study in the forensic utility of the Health Index. Presented at the American Academy of Forensic Sciences 63rd annual meeting. Chicago, IL.

Paxton FS (1990). Christianizing death: The creation of a ritual process in early Medieval Europe. Ithaca, Cornell University Press.

Perry MA (2005). Redefining childhood through bioarchaeology: Toward an archaeological and biological understanding of children in antiquity. Archaeological Papers of the American Anthropological Association 15:89-111

Perry MA (2007). Is Bioarchaeology a Handmaiden to History? Developing a Historical Bioarchaeology. Journal of Anthropological Archaeology 26:486-515.

Peterson RO, Vucetich JA, Fenton G, Drummer TD, Larsen CS (2010). Ecology of arthritis. Ecology Letters. 13:1124-1128.

Pietrusewsky M, Douglas MT (2002). Ban Chiang, a prehistoric village site in northeast Thailand. I, the human skeletal remains. Thai archaeology monograph series; 1. University Museum monograph; 111. Philadelphia, University of Pennsylvania.

Powell ML (2007). Of time and the River: Perspectives on health during the Moundville chiefdom. In: Archaeology of the Moundville chiefdom, Knight VJ, Steponaitis VP (editors) Alabama, University Alabama Press:102-119.

Ramsey JF (1973). Spain: The rise of the first world power. Alabama, University of Alabama Press.

Rebillard E (2003). The care of the dead in late antiquity. Ithaca, Cornell University Press.

Reilly BF (1993). The medieval Spains. Cambridge, Cambridge University Press.

Requejo Pagés O, Jiménez Sánchez M, Javier Alonso Rodríguez F (2009). La iglesia de San Miguel de Lillo (Oviedo): Obras de conservación y actuación arqueológica (2005-2006). In: Fernández Reyero J, García de Castro Valdés C. (editors) Excavaciones Arqueologicas en Asturias 2003-2006. Gijon, Ediciones Trabe S. L. U.:339-346.

Ríos GS (2010). Excavación arqueológica en la capilla de San Lorenzo de Cortina. LLaranes Viejo. Avilés. Informe.

Robb J, Bigazzi R, Lazzarini L, Scarsini C, Sonego F (2001). Social "status" and biological "status": A comparison of grave goods and skeletal indicators from Pontecagnano. American Journal of Physical Anthropology 115:213-222.

Rose JC, Armelagos GJ, Lallo JW (1978). Histological enamel indicator of childhood stress in prehistoric skeletal samples. American Journal of Physical Anthropology 49:511-516.

Ruiz TF (2007). Spain's Centuries of Crisis: 1300-1474. Massachusetts, Blackwell Publishing.

Ruiz A, Molinos M (1998). The archaeology of the Iberians. Cambridge, Cambridge University Press.

Russel JC (1948). Demographic pattern in history. Population Studies 1(4):388-404

Semeraro DS, Passalacqua NV (2007). Dimorphism in the radial head diameter and its potential for sex determination. Poster presented at the American Association of Physical Anthropology 76th annual meeting. Philadelphia, PA.

Siegfried M (1986). The skewed sex ratio in a medieval population: A reinterpretation. Social Science History 10(2):195-204 .

Šlaus M (2008). Osteological and dental markers of health in the transition from the late Antique to Early Medieval period in Croatia. American Journal of Physical Anthropology 136(4):455-496.

Šlaus M, Bedić Ž, Rajić Šikanjić P, Vodanović M, Domić Kunić A (2011). Dental health at the transition from the Late Antique to the early Medieval period on Croatia's eastern Adriatic coast. International Journal of Osteoarchaeology 21:577–590.

Smith AFM, Gelfand AE (1992). Bayesian statistics without tears: A sampling-resampling perspective. The American Statistician 46(2):84-88.

Sokal RR, Rohlf FJ (1995). Biometry: The principles and practice of statistics in biological research. New York, W.H Freeman and Company.

Spradley MK (2006). Biological anthropology aspects of the African diaspora: Geographical origins, secular trends, and plastic versus genetic influences utilizing craniometric data. PhD Dissertation. University of Tennessee, Knoxville.

Steckel RH (2004). Historical perspective on the standard of living using anthropometric data. In: Wolff EN, Elgar E (editors) What has happened to the quality of life in the advanced industrialized nations? Edward Elgar Publishing:257-274.

Steckel RH, Rose JC (2002). The Backbone of History: Health and nutrition in the Western Hemisphere. Cambridge, Cambridge University Press.

Steckel RH, Sciulli PW, Rose JC. (2002). A Health Index from Skeletal Remains. In: The Backbone of History: Health and Nutrition in the Western Hemisphere Richard H. Steckel and Jerome C. Rose (editors). New York, Cambridge University Press

Steckel RH, Larsen CS, Sciulli PW, Walker PL (2005). The Global History of Health Project: Data collection codebook. http://global.sbs.ohio-state.edu/

Steckel RH, Kjellström A, Rose J, Larsen CS, Walker PL, Blondiaux J, Grupe G, Jankauskas R, Maat G, McGlynn G, Papathanasiou A, Roberts C, Teschler-Nicola M, Wittwer-Backofen U, Agnew A, Assis S, Bereczki Z, Bertrand B, Betsinger TK, Boulter S, Bourbou C, Boylston A, Brickley M, Bürli L, Cooper C, Coppa A, Coughlan J, Drozd A, During E, Eng J, Engel F, Fox S, Furtado M, Gerhards G, Haebler K, Harkins K, Holck P, Holst M, Hotz G, Justus H, Kaminska K, Knüsel CJ, Kozlowski T, Lagia A, Lopes C, Manolis S, Marcsik A, Marques C, Moenke C, Niel C, Novak SA, Novotny F, Peck J, Potiekhina I, Rega B, Richman R, Rijpma F, Ruiz J, SannenP , Sciulli P, Soficaru A, Spannagl M, Storm R, Subirà E, Swales D, Tritsaroli V, Tyler E, Ulrich-Bochsler S, Vatteoni S, Villena-Mota N, Wiggins R, Williams LL (2009). Summary measurement of health and wellbeing: The health index. Poster presented at the American Association of Physical Anthropology 78th annual meeting. Chicago, IL

Stuard SM (1984). The sociobiological model and the Medieval evidence. American Anthropologist 86(2):410-413

Stuart-Macadam P (1989). Nutritional deficiency disease: a survey of scurvy, rickets, and iron-deficiency anemia. In: Iscan M, Kennedy K (editors). Reconstruction of life from the skeleton. New York, Wiley-Liss:201-222.

Suarez Fernandez L (1972). The kingdom of Castile in the fifteenth century. In: Highfield R (editor). Spain in the fifteenth century: 1369-1516. London, Macmillan.

Suddick RP, Harris NO (1990). Historical perspectives of oral biology: a series. Critical Reviews in Oral Biology and Medicine 1:135–151.

Tamura Y, Welch DC, Zic AJ, Cooper WO, Stein SM, Hummell DS (2000). Scurvy presenting as a painful gait with bruising in a young boy. Archives of Pediatrics and Adolescent Medicine 154:732–735.

Thomas DH (1978). The awful truth about statistics in archaeology. American Antiquity 43(2):231-244.

Toynbee JMC (1971). Death and burial in the Roman world. Boston, The Johns Hopkins University Press.

Tung TA (2003). A bioarchaeological perspective on Wari Imperialism in the Andes of Peru: A view from heartland to hinterland skeletal populations. PhD Dissertation. University of North Carolina, Chapel Hill

Ubelaker DH, Rife JL (2007). The practice of cremation in the Roman-era cemetery at Kenchreai, Greece: The perspective from archeology and forensic science. Bioarchaeology of the Near East (1):35-57.

Vodanović M, Brkić H, Šlaus M, Demo Ž, (2005). The frequency and distribution of caries in the mediaeval population of Bijelo Brdo in Croatia (10th–11th century). Archives of Oral Biology 50:669–680.

Uhl NM, Passalacqua NV (2009). A comparison of estimated age-at-death distributions using bioarchaeological and forensic methods. Poster presented at the American Association of Physical Anthropology 78th annual meeting. Chicago, IL

Waldron T (1991). Rates for the job. Measures of disease frequency in paleopathology. International Journal of Osteoarchaeology 1:17-25.

Waldron T (2007). Paleoepidemiology: The epidemiology of human remains. Wallnut Creek, Left Coast Press, Inc.

Walker PL, Bathurst RR, Richman R, Gjerdrum T, Andrushko VA (2009). The causes of porotic hyperostosis and cribra orbitalia: A reappraisal of the iron-deficiency-anemia hypothesis. American Journal of Physical Anthropology 139(2):109-125.

Wapler U, Crubézy E, Schultz M (2004). Is cribra orbitalia synonymous with anemia? Analysis and interpretation of cranial pathology in Sudan. American Journal of Physical Anthropology 123:333-339

Webb D (1999). Pilgrims and pilgrimage in the medieval west. New York, I.B. Tauris & Co Ltd.

Williams HMR (1997). Ancient Landscapes and the dead: the reuse of prehistoric and Roman monuments as early Anglo-Saxon burial sites. Medieval Archaeology 41:1-31.

Williams HMR (1999). Identities and cemeteries in Roman and early medieval Britain. Proceedings of the Eighth Annual Theoretical Roman Archaeology Conference:89-107.

Williams HMR (2005). Review article: Rethinking Medieval mortuary archaeology. Early Medieval Europe 13(2):195-217.

Williams HMR (2007). Depicting the Dead: Commemoration through cists, cairns, and symbols in early medieval Britain. Cambridge Archaeological Journal 17(2):145-164.

Wilson JJ (2010). Modeling life through death in late prehistoric west-central Illinois: An assessment of paleodemographic and paleoepidemiological variability. PhD Dissertation. SUNY Binghamton.

Winks RW, Ruiz TF (2005). Medieval Europe and the world: From late antiquity to modernity, 400-1500. New York, Oxford University Press.

Woolf G (1997). Beyond Romans and natives. World Archaeology 28(3):339-350.

Woolf G (1998). Becoming Roman: The origins of provincial civilization in Gaul. Cambridge, Cambridge University Press.

Wood JW, Milner GR, Harpending HC, Weiss KM (1992). The osteological paradox. Current Anthropology 33(4):343-370.

Wright LE, Yoder CJ (2003) Recent progress in bioarchaeology: Approaches to the osteological paradox. Journal of Archaeological Research, 11(1):43-70.

Zadora-Rio E (2003). The making of churchyards in the early medieval landscape of France and England in the 7^{th}-12^{th} centuries: A reconsideration. Medieval Archaeology 19:1-19.