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Bioarchaeology in the Roman Empire

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Without Abstract

State of Knowledge and Current Debates

Much of a person's life history is written on his or her bones. Skeletal remains of past populations are palimpsests of information about the behaviors people engaged in during their lives. The bioarchaeological study of burials from around the Roman Empire is a relatively new undertaking but has proven to be an essential line of evidence for understanding the demographic makeup, health status, and dietary regimes of the heterogeneous peoples that comprised the imperial population. Bioarchaeologists are therefore leading the way in answering questions about the life experiences of all social classes in the Roman Empire. By integrating bioarchaeological studies with traditional analyses of material culture and texts and with innovative and interdisciplinary biochemical analyses, the diversity of the Romans in all areas of the Empire is becoming apparent.

State of Knowledge

Bioarchaeology is the study of skeletal remains from archaeological sites (Buikstra *1977*; Larsen *2015*; Martin et al. *2013*). The term osteoarchaeology is also used, primarily in Europe, and through the years both terms have been broadly defined as including skeletal material from both humans and animals. Owing to the influence of New Archaeology, however, since the 1970s, bioarchaeology has conventionally dealt with the physical remains of humans from burials found in the archaeological record. In the USA, bioarchaeology is considered a subspecialty of biological anthropology, whereas in Europe the field is more closely allied with archaeology and anatomy.

An individual skeleton is the unit of analysis in bioarchaeology, but inferences about past behavior can only be reconstructed through a survey of the population and its sociocultural context. As such, bioarchaeology is an interdisciplinary field, incorporating techniques and theoretical approaches drawn largely from biology, chemistry, anatomy, demography, anthropology, and archaeology. When used as a way to study the people of the Roman Empire, bioarchaeology also draws from classical philology, historiography, epigraphy, architecture, and artifact studies in order to situate the skeletal population under consideration within a cultural milieu.

In one sense, the roots of classical bioarchaeology can be found in ancient authors. In the mid-fifth century BCE, Herodotus, reporting on the aftermath of a Persian War battle (*Histories* 3.12.2-3), noticed that the skulls of the Persians were brittle, whereas those of the Ethiopians were quite strong, and he attributed this difference to sun exposure by the Africans. While Herodotus was not correct in this correlation, his observation foreshadowed discussions in biological anthropology of the effects of the environment on the human skeleton.

The osteological study of burials has been a part of Roman archaeology since at least the nineteenth century. At this time, cursory analysis of skeletons with the objective of culling demographic histories was always subsumed by publication of grave goods in large site reports, sending biological material to languish in appendices. The biological sex of a skeleton was assigned based on associated artifacts as often as it was estimated by biological markers. In the early twentieth century, biological anthropology in the USA and Europe developed similarly, as researchers attempted to look at skeletons, especially the skull, for evidence of diffusionary traits. Coupled with such pseudoscientific tools as Retzius' cephalic index, biological anthropology in Italy, for example, became heavily invested in discovering the "true race" of the Italians and explaining the Mezzogiorno and American anthropology in finding a biological basis to support the practices of slavery, racism, and forced removal of Natives. Skeletal measurements, when twisted to fit preconceived notions of racial superiority, represented both a reliance on early empiricism and the rise of nationalist movements in Europe and America. This legacy of cranial indices and -cephalic suffixes, unfortunately, is still seen today in some Mediterranean bioarchaeological publications, but the field has evolved immensely in the last decade.

Bioarchaeology in the English-speaking world arose as an independent field of research in the 1970s under the guidance of US anthropologist Jane Buikstra and other proponents of the science-focused New Archaeology. Researchers began to study skeletal collections housed around the world in order to answer research questions beyond chronology and typology of burials. In the 1980s, with the advent of post-processual archaeology, bioarchaeologists started asking how diet, behavior, and disease differed along the lines of status and gender. By the 1990s, bioarchaeology was coming into its own. Data recording practices and techniques were standardized in the USA (Buikstra and Ubelaker *1994*), and European researchers similarly adopted their own standards (e.g., Brickley and McKinley *2004*). At the end of the twentieth century, several international laboratories and research centers that deal with classical bioarchaeology had been established, such as the Wiener Laboratory at the American School of Classical Studies at Athens, the Servizio di Antropologia of the Soprintendenza Speciale per i Beni Archeologici di Roma, the Centre National de la Recherche Scientifique in France, and English Heritage in the UK.

In the twenty-first century, bioarchaeology increasingly employs chemical techniques such as isotope and DNA analyses to answer questions about population interaction, dietary differences, and the origin and spread of disease. There has also been a trend toward osteobiography or creating detailed, individualized life histories from skeletal remains, often accompanied by a forensics-based facial reconstruction. Classical bioarchaeology today is balancing scientific and humanistic approaches in order to understand life in antiquity.

Current Debates

Although classical archaeology was founded on an historical tradition in which material remains were mainly used to illustrate the vast body of Latin literature, today's Roman bioarchaeologists ask their own questions about what life was like in ancient times, in part to provide a history to those segments of society that did not merit inclusion in elite writing. Key areas of Roman bioarchaeology research in the past decade have focused on questions about diet, migration, and disease in the Empire. The majority of this research has been done on skeletal assemblages from Italy and from Britain and has been published in the traditional venue of peer-reviewed anthropology journals. As more bioarchaeologists have begun focusing on the periphery of the Empire, however, new research can be found in a variety of languages and publication venues. There is additionally a growing movement toward synthetic treatment of bioarchaeological data from the classical world that is reaching an audience made up of anthropologists, classicists, historians, and the general public.

1.

Diet: What Were People Eating Around the Empire?

The Imperial Roman diet, particularly for the lower classes, has been reconstructed primarily through the agricultural writings of authors such as Cato, Varro, and Columella. People in all parts of the Empire subsisted on cereals, fruits, and vegetables generally in the form of bread, olive oil, and wine. There is little evidence in historical records, however, of the diversity that existed in the Roman diet, and there has been disagreement about the role of seafood and the consumption of millet. Bioarchaeologists have weighed in with chemical analyses of skeletal tissue in an effort to demonstrate that different imperial populations used different alimentary resources.

Carbon and nitrogen isotope analyses from bone collagen yield a general picture of a person's diet in the years leading up to death. Because carbon enters the food chain through photosynthesis, a human's carbon isotope ratio is largely affected by the kind of plants he or she ate. Additionally, there are two major photosynthetic pathways, which mean that carbon isotopes can distinguish a diet reliant on temperate grasses such as wheat and barley from a diet reliant on tropical grasses such as millet and sorghum. Nitrogen in the human diet is obtained primarily through consumption of other organisms, so understanding nitrogen isotopes means understanding an organism's position in the food chain. The values of nitrogen isotopes therefore range from very low, indicating a diet composed of legumes, to very high, indicating a diet composed primarily of aquatic resources.

Isotope research on skeletons from Imperial Italy has shown great differences in diet. In the shadow of the city walls of Rome, people were eating more millet and less seafood than were people from Portus Romae (Prowse et al. 2004; Killgrove and Tykot 2013, 2017). Skeletons from the early Christian necropolis of San Callixtus in the Roman suburbs further revealed an ascetic diet for this religious group, with consumption of freshwater fish from the Tiber River (Rutgers et al. 2009). Correlation between frequency of external auricular exostosis, an ear pathology related to cold water immersion, and nitrogen isotope values for people from Portus and Velia, a site on the Tyrrhenian coast, further demonstrates that the population of Imperial Italy was indeed consuming both freshwater and saltwater resources (Craig et al. 2009; Crowe et al. 2010). Differences in diet at Portus have also been found to reflect age, with children eating more terrestrial food and older adults consuming more olive oil and wine (Prowse et al. 2005), and there is evidence that foreigners at Rome changed their diet after immigrating and consumed less millet (Killgrove and Montgomery 2016). Further south, dietary isotope research on Herculaneum (Craig et al. 2013; Martyn et al. 2017) has produced data on varied diets that line up with archaeological and paleobotanical studies from the site.

Outside of Italy, palaeodiets varied within populations and through time in Roman Britain (Müldner 2013); nevertheless, isotope studies on several skeletal series have revealed that Romano-British people ate a largely terrestrial diet composed of plants, meat from herbivores, and a small amount of marine or freshwater fish. Other studies have focused on sites along the Roman *limes*, such as at Leptiminus in Tunisia (Keenleyside et al. 2009), the Dalmatian Coast of Croatia (Lightfoot et al. 2012), Denmark (Jørkov et al. 2010), and Spain (López-Costas and Müldner 2016), and similarly reveal a wide range of exploited foodstuffs. Whereas people in North Africa were eating some marine resources and adult diet was different from kids' diets, there was virtually no consumption of fish in Denmark, and everyone was eating similar food. Croatia and Spain provide evidence that being part of the Empire affected people's daily diets; while the Roman period meant more marine resources

consumed in Croatia, in Spain the transition to a higher marine diet happened in the post-Roman period.
Chemical analyses of skeletal remains are therefore providing bioarchaeologists with information about the diets of individuals and of populations throughout the Empire, giving new insight particularly into the diet of lower-class Imperial residents. Finally, a newly published, open-access database of isotopes in the Greco-Roman world called IsoArcH is poised to generate breakthroughs in both palaeodiet and migration questions in the coming years (Salesse et al. 2017).

2.

Migration: How Were People Moving Around the Empire?

The phenomenon of migration and its implication for the demographic structure of the Empire has previously been investigated through census records and inscriptions on tombstones. As the center of Imperial power, Rome itself had a great number of free immigrants and slaves who hailed from elsewhere. Identifying immigrants and slaves in the archaeological record has been challenging, however, because most were not noted as such in inscriptions or through artifact assemblages in graves. A major contribution of bioarchaeology in recent years has been the application of chemical techniques to identify population diasporas within the Empire.
Isotopes of strontium and oxygen are most commonly used to distinguish immigrants from locals in a skeletal assemblage. Strontium is incorporated into the human body during growth via groundwater, and the strontium isotope ratio derived from a human's dental enamel reflects the geology of the area in which the person grew up. Lower strontium values generally indicate younger geology, such as volcanic areas, while higher values are indicative of older rock. Oxygen isotopes incorporated during tissue development are related to the overall climate of the area; lower values suggest a person grew up in a colder, wetter climate, and higher values suggest life in a warmer, drier climate. Some strontium and oxygen isotope studies have been done in the Roman Empire, but until significantly more data are available, interpretations are necessarily conservative in nature.
In the Roman suburbs, a strontium and oxygen study of dental enamel from the first molar, which forms between birth and 3 years of age, revealed numerous people who arrived at Rome from elsewhere (Killgrove and Montgomery 2016). Many of these immigrants to Rome apparently ate different diets as children, as the carbon isotopes demonstrated. Similarly, an oxygen isotope analysis of the first, second, and third molars from individuals buried at Portus Romae suggested a large chunk of the population moved there during childhood (Prowse et al. 2007), but work at Velia in southwest coastal Italy found no potential immigrants (Stark 2017). It is not currently possible to pinpoint an immigrant's homeland, but general trends in the data from Imperial Italy suggest that people were arriving in these cities from nearby areas such as the Apennines but also from areas with strikingly different geology and climate. Further, research on migration in the Roman suburbs suggests that the practice was not confined to young men, as there is ample evidence of immigrant women and children in the bioarchaeological record.
Migration did not occur just to Rome and to other large urban centers. In Southern Italy, a combination of oxygen isotope and ancient DNA analysis revealed an adult female with East Asian ancestry, whose burial form and grave goods otherwise did not indicate she originated elsewhere (Prowse et al. 2010). In the Romano-British burial ground of Spitalfields, a woman who was buried in a decorated lead coffin was shown through Pb isotope analysis to have originated in Rome (Montgomery et al. 2010). Several strontium and/or oxygen isotope studies have been conducted on Romano-British skeletal series in the past decade; by and large, they reveal a great deal of mobility in the area. At the sites of York, Gloucester, and Lankhills, for example, only about half of the people studied could be considered locals, while about 15–20% were from elsewhere in England, and 20–35% were long-distance migrants. Even far-flung areas like Aila in Jordan boasted immigrants during

the Empire. A strontium study at that site found that the vast majority of people came from distant homelands, likely as workers to support its role as a trade center (Perry et al. 2017).

Isotope analyses of skeletal tissue are therefore yielding new information on patterns of migration within the Roman Empire as well as on the demographic makeup of both urban and rural settlements. Physical mobility within the Empire was quite high, and immigration was not by any means unidirectional. In many places, the importation of food and use of aqueducts complicates the interpretation of the isotope data. The reasons for population mobility are also still largely uncertain. Diasporas of people likely occurred with slavery and to a lesser extent with military service, but migration may also have been an option for families and for free individuals looking for work or for a spouse. The growing database of strontium and oxygen isotope data is revealing the great distances that people migrated in antiquity, and new applications of DNA analysis point the way forward for bioarchaeologists interested in contributing to the conversation about mobility and migration in the Empire. In the future, the challenge will be to integrate the scientific data drawn from chemical analyses of skeletons with the historical evidence from inscriptions and censuses to glean new information about the demographic fluctuations of imperial populations.

3.

Disease and Health: Who Got Sick in the Roman Empire?

Only within the last 10 or 15 years have reports of trauma and disease in the archaeological record evolved from case studies of pathological conditions to large-scale research into the prevalence of specific diseases in imperial populations. The recent debate on health in the Roman Empire starts with a look at systemic factors that may have increased people's stress, including urbanization, malnutrition, hygiene, and sanitation, as well as the comorbidity of various infectious diseases and parasites. The health of an individual and of a population is multifaceted, and researchers have employed skeletal remains from both Rome and Britain, in addition to primary and secondary source material, to argue that the Empire was not a particularly salubrious place to live.

Pathological data from several skeletal series in Rome have been published (e.g., Piccioli et al. 2015), although much of the information comes from incompletely analyzed skeletal series. Most research suggests that there were significant health stressors for people living in the city and suburbs, as evidenced by high frequencies of enamel hypoplasia and cribra orbitalia and by a decrease in overall stature during the Empire. Hypoplasias are defects in the formation of dental enamel and can be caused by a number of health issues, including malnutrition, disease, and weaning; cribra orbitalia is generally considered to result from iron-deficiency anemia, which in turn can be caused by nutritional deficiencies or disease; and variation in adult stature, particularly a trend in shorter stature, results when an individual is stressed during childhood, as from disease or malnutrition. In general, skeletal series from Rome show higher frequencies of enamel hypoplasia and cribra orbitalia and shorter stature than do series from Britain, likely owing to the urban nature of Rome, which had high population density and unequal resource allocation. Through time, the British skeletal series also provide evidence for a decrease in stature as well as increased exposure to anthropogenic lead in the Roman period. One suggestion for the decline in health during the Roman Empire is the presence of endemic malaria in the Mediterranean. Malaria in antiquity has been the subject of debate for a number of years; however, the skeletal evidence is still inconclusive, particularly since not all Roman skeletal series show high frequencies of cribra orbitalia. Currently, understanding disease frequencies around the Empire is complicated by the lack of standardization in data collection practices, by the lack of analyses of large cemetery series, and by the focus on individuals and on specific, unusual pathologies (Killgrove 2017, 2018).

DNA analysis may present a way forward in studies of disease in the Roman Empire, although this technique is still very new. Using pathogen DNA analysis to identify the genes of organisms responsible for disease, recent research has discovered evidence of malaria in two individuals who lived in Italy during the early Empire (Marciniak *2016*; Marciniak et al. *2016*), has found a case of leprosy outside of Rome in the middle Empire (Rubini et al. *2014*), and has determined that the cause of the Justinian plague in the sixth century CE was the same organism that caused the Black Death centuries later (Wagner et al. *2014*; Harbeck et al. *2013*). While pathogen DNA analysis is still time-consuming and expensive, it is likely that in the coming years, technology will advance and lower these barriers to testing Roman remains. A complementary technique is paleoparasitology, in which ancient soil or sewage is microscopically examined for evidence of parasite eggs. This technique so far has produced widespread evidence of roundworm and whipworm in the Roman Empire (Mitchell *2017*; Dufour et al. *2016*) as well as the protozoan *Giardia* (Williams et al. *2017*).

In spite of these advances, it remains difficult to fully understand morbidity and mortality in a population, as they are complicated processes dependent on a variety of environmental and sociocultural factors. With few fully published skeletal series outside of Roman Britain, the disease ecology within the Empire as a whole is still largely unknown. Research that synthesizes the available historical and osteological information on population size, sanitation, nutrition, and disease is becoming more common in bioarchaeological research in general, opening up a worldwide discussion about health and disease in antiquity (e.g., Harper *2017*; Scheidel *2018*). Combined with the growing use of chemical techniques to identify pathogens, bioarchaeological research is beginning to produce novel information about health in the Roman Empire.

4.
International Outreach

The international picture of Imperial Roman bioarchaeology in the twenty-first century is considerably wide ranging, although still concentrated largely on Italy, Britain, and Greece, which have produced a wealth of skeletal remains in the past few decades. In the former Roman provinces, work is underway in Aegyptus, Arabia Petraea, Africa Proconsularis, Dalmatia, Gaul, Germania, Hispania, and Asia Minor, to name a few. Although the population of bioarchaeological practitioners has diversified since the end of the twentieth century, British researchers remain at the forefront of the field, thanks to large skeletal series such as Poundbury Camp and cutting-edge technology. The bioarchaeology of Roman Britain is yielding in-depth reports on paleopathology, demography, mobility, and diet. These techniques are just beginning to be applied in Italy at Rome, at circum-Vesuvian sites, and at suburban and rural sites by Italian researchers affiliated with the archaeological superintendencies and universities and by European and North American scholars. Although there is not yet an international database of Roman skeletons, a movement toward data sharing and open access is underway in American biological anthropology, which will pave the way for synthetic treatments of bioarchaeological information by its international creators. Additional data are starting to come out in the form of 3D scans and photogrammetric models produced by Roman bioarchaeologists and archaeologists.

In this age of digital connections, however, information on classical bioarchaeology is being shared across linguistic divides not just at international conferences but also through social networking, newsgroups, blogs, and interdisciplinary journals. This includes academic researchers writing about classical history and archaeology news, for instance, Kristina Killgrove and Sarah E. Bond both write online columns at Forbes.com. Additionally, a multitude of other blogs and websites exist as Roman bioarchaeology moves to embrace the digital humanities and public outreach.

Future Directions

The past decade has seen bioarchaeological research expand from the core of the Roman world to the lesser-investigated provinces of the Empire. More work is needed, however, in places like Hispania, Gaul, Illyricum, Asia Minor, Syria, and Judaea. The city of Rome itself has produced thousands of skeletons in recent years, but most cemeteries remain at least partially unpublished, making synthetic treatments challenging at the moment. Future studies at both the center and periphery of the Empire will make it easier to understand the diversity of the heterogeneous peoples who comprised the imperial population.

Moving forward, Roman bioarchaeologists will be able to address research questions about disease ecology, identity formation, and population interaction. Paleopathological research has primarily been focused on identifying diseases in the skeletal record of the Roman Empire, but more could be done to understand the ecology of those diseases. In Rome, for example, wildly varying frequencies of skeletal markers of stress and infection suggest living in different areas of the city and suburbs put people at different risk for diseases such as malaria. Investigating the topography, climate, and water sources of Rome is just as important as doing macroscopic and chemical analyses of skeletons for understanding morbidity patterns, and a bioarchaeological approach that incorporates disease ecology will move the study of Roman health forward.

Isotope and DNA analyses have already yielded key information about migration within the Roman Empire, by isolating individuals who traveled to and from Italy during their lifetimes. These data, however, have seldom been used to draw conclusions about identity formation in the multiethnic Empire, which would be a key step forward for Roman bioarchaeology. Pushed even further, data from chemical analyses combined with material remains and demographic models may allow Roman bioarchaeologists to investigate the practice of slavery in a novel manner. With more isotope analyses and additional DNA studies, a bioarchaeological approach to understanding Roman slavery cannot be far off.

Almost 40 years ago, Colin Renfrew (*1980*: 297) wrote that there was a place "for anyone who can command the data and the scholarship of the Great Tradition while employing the problem-orientation and the research methods of current anthropological archaeology." Bioarchaeologists who work in the Roman Empire have taken up this challenge and are weaving together scientific and humanistic data on a daily basis. Roman archaeology has already benefitted immensely from a bioarchaeological approach that integrates textual, artistic, and other material evidence with biological remains to create a more holistic picture of all levels of life and culture in the Roman world.

In the past decade, bioarchaeological research in the Roman Empire has surged from basically nothing to an active international research program tackling difficult questions about diet, disease, and demographics from a scientific standpoint. Bioarchaeologists in the Roman world have only recently begun to reflect on the accumulated data, yet bioarchaeological approaches have already clearly demonstrated that the Roman Empire was a strikingly diverse place. Heterogeneous groups of people from different homelands lived in cities, rural outposts, and forts on the *limes*. Their diets were composed primarily of cereals, meat, and plants, but the proportions of these resources and the types consumed differed dramatically. The people likely differed biologically in their risk of mortality and culturally in their attempts to mitigate disease and induce health. The last decade of research has demonstrated that literature is a great way of framing life in the Roman Empire but that bioarchaeology is necessary to complete the picture.

Cross-References

- Archaeoparasitology

Bioarchaeology, Human Osteology, and Forensic Anthropology: Definitions and Developments
Bioarchaeology: Definition
Bone Chemistry and Ancient Diet
Bone: Chemical Analysis
Burial Practices and Tombs in the Roman World
Demography of the Ancient Roman World
Digital Ethics in Bioarchaeology
DNA and Skeletal Analysis in Bioarchaeology and Human Osteology
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