Giulia Riccomi

Bioarchaeology and Dietary Reconstruction across Late Antiquity and the Middle Ages in Tuscany, Central Italy

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Archaeopress Archaeology

Archaeopress Publishing Ltd
Summertown Pavilion
18-24 Middle Way
Summertown
Oxford OX2 7LG

www.archaeopress.com

ISBN 978-1-78969-865-7
ISBN 978-1-78969-866-4 (e-Pdf)

Cover: Burial T. 59. Child deposed in enchytrismòs (4th -5th centuries AD) from the urban necropolis of Via Marche (Pisa, Italy) (from Paribeni, Cerato, Costantini, Ghizzani Marcìa, Mileti, & Rizzitelli, 2012, Via Marche/Via Abba-Scavo preventivo (Dataset), Pisa: MOD doi:10.4456/MAPPA.2012.28)
Back Cover: Pava'08 US 8432. Mild form of linear enamel hypoplasia affecting the left mandibular canine ad premolars (© G. Riccomi).

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Foreword

The period spanning Late Antiquity (3rd to 5th century AD) to the Middle Ages (6th to 15th century AD) has long left its mark on the historical consciousness of Europe. In particular, there has been considerable debate as to what happened to social, economic, and political organisation in different regions following the collapse of the Western Roman Empire. Although earlier research, popular sources, and public consciousness can paint the picture of a world plunged into 'darkness', often echoing our own fears of what the future might hold for western societies in the 21st century, growing academic work over the last two decades has increasingly revealed the dynamic and innovative forms of agriculture, settlement, long-distance exchange and trade, and political control that emerged in Europe following the end of the Classical period.

Such lines of enquiry have been especially intense in Italy, as the former heart of one of the largest empires ever to have existed and the geographical area that perhaps had the most to lose following the abandonment of the classical Roman imperial structure. In rural areas, it has been suggested that there was a widespread abandonment of rural Roman *villae* that had provided the key model of agrarian food production. Other scholars have described the complete depopulation of most of the Italian countryside. Nevertheless, more recently, historians and archaeologists have argued that there was actually rather a gradual reconfiguration of the relationship between urban and rural realms, with local independence leading to diverse, context-specific, resilient agricultural adaptations during the Early Middle Ages.

Testing these scenarios has been challenging due to a lack of direct methodologies for determining how local communities practically experienced wider social, political, and economic changes. Literary sources and archival records have been frequently relied upon, and have noted changes in demography, hierarchical access to resources, and culinary practices – although they are often sparse and only relate to certain, often elite, sectors of society. Detailed osteoarchaeology and biomolecular methodologies, such as stable isotope analysis, have been shown to have immense promise of directly studying the diet, nutrition, and experiences of individuals in the past, including in the Classical period and the Middle Ages. However, diachronic studies, from Classical to post-Classical times, have rarely been attempted within Italian bioarchaeology. Furthermore, only a few studies address the consequences of sociocultural transitions for living conditions viewed through multiple skeletal and dental stress markers.

From this perspective, the volume based on the PhD thesis of Dr. Giulia Riccomi represents a major step forward. In it the author applies a multidisciplinary framework to human remains excavated from Late Antiquity (3rd-5th centuries AD) and the Middle Ages (mid 6th-mid 13th centuries AD) funerary contexts from the three sites of Via Marche, v*icus Wallari/borgo San Genesio*, and Pieve di Pava in Tuscany, central Italy. By reconstructing detailed insights into human dietary reliance on different food groups and changes in skeletal stressors and markers of health between the two time periods, between rural and urban contexts, and between social groupings for the first time, the study provides novel data relating to the actual human implications of social, economic, and political reconfiguration among communities living at the core of a vast empire.

The osteoarchaeological research demonstrates that there may actually have been an improvement in living conditions in this part of rural Italy between Late Antiquity and the Middle Ages, in terms of longer life expectancy for individuals and an increased male stature. Other skeletal stress markers, such as *cribra orbitalia* and periosteal reaction show no clear pattern of change, but certainly no clear evidence for a shift towards an impoverished 'Dark Ages'. Similarly, linear enamel hypoplasia reveals no diachronic discrepancy in terms of prevalence between the two periods, although the age of onset of the defects seems to suggest different 'weaning' practices. Meanwhile, the stable isotope data shows evidence for a growing inclusion of millet, alongside wheat, in human diets, as well as regional variability, something the author interprets as part of a growing diversity of locally-resilient agricultural systems and cultural preferences during the Middle Ages.

While Dr. Riccomi notes that there are some limitations of the study, including imbalanced temporal representation of urban and rural contexts and potential sample size issues for making inferences at the population level, the results, as she notes, allow us to begin to 'explore the ways in which communities perceived and reacted to change during the passage to post-Classical times in the Mediterranean area...'. As well as crucial, novel data, the study, performed by a scholar who has practical and theoretical experience in two very different skillsets, provides an important

model for the type of integrated multidisciplinary research that can begin to elucidate the health, cultures, and economic experiences of the varied communities navigating the post-Classical European world, contributing to a broader discussion of living conditions in the Mediterranean of the 1st millennium AD.

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Acknowledgements

This research project running back to my three-years PhD (2016-2019) at the University of Pisa (Italy), which has been my alma mater for BA and MSc. degrees. I gratefully acknowledge all the parties from which I received financial support during my doctoral programme, including the University of Pisa, the Max Planck Society, the Division of Paleopathology and the Department of Anthropology at UC Berkeley.

The book proposal to Archaeopress was generated after defence of my PhD dissertation in March 2020 as the referees, Ana Luísa Santos and Patrick Roberts, and then the external examiners, Maria Giovanna Belcastro and Sylvia Jiménez-Brobeil, saw something to get excited about in my work. Thank you for your very positive comments and to have taken part in my oral defence in the middle of the COVID-19 outbreak. They all have provided valuable feedback and I bear full responsibility for any errors or inconsistencies that this volume may contain.

Since 2016 when I started my PhD, I have incurred a host of debts to colleagues near and far who have listened and inspired my developing ideas, including Valentina Giuffra, Simona Minozzi and Patrick Roberts. Thank you for your continuous support and guidance without which I would not be the researcher I am.

I am indebted to those who helped me during my stays abroad and took the time for assisting me in carrying out the stable isotope analyses: Jana Zech and all the technicians of the laboratory of the Stable Isotope Laboratory at the Max Planck Institute for the Science of Human History; Katie Kinkopf and Sabrina Agarwal, Stefania Mambelli and Wenbo Yang at UC Berkeley.

Special thanks go to Gino Fornaciari, Antonio Fornaciari, and Laura Cignoni for their positive encouragement and advice over the years, and to Laura Manca for her help in revising statistical data but also, and especially, for her sincere appreciation and optimism. I wish to thank Angelica Vitiello and Valeria Mongelli who helped me during the very early stages of the PhD project taking the time to answer my archaeology-based queries and to collect osteological material analysed in this research.

I would also like to thank those who played a less direct, but still important, role in this work: Stefano Campana and Cristina Felici for providing help with the archaeological and photographic documentation concerning the site of Pieve di Pava; Federico Cantini and Claudia Rizzitelli for providing help with photographic documentation of the archaeological sites of *vicus Wallari/borgo San Genesio* and Via Marche, respectively; Andrea Augenti who made explicit that Figure 6A was freely available. Many thanks to Silvia Buonincontri and Laura Landini for assisting me with the zooarchaeological specimens used for stable isotope analysis.

For various forms of technical support and assistance, I would like to thank the team at Archaeopress for their enthusiasm for this monograph, particularly to my editors, David Davison and Rajka Makjanic for their patience and hard work in bringing it to publication. Gerald Brisch and Danko Josic were very supportive during the copyediting and the laying out process respectively, and a pleasure to work with.

Thanks to my friends and colleagues Giorgia Tulumello and Martina Monaco, for being in my corner, to Linda Castañeda for her precious advice, chats and funny adventures across California. A very deep thank you goes to my friend Giulia Ragazzon for her continuous emotional and practical support.

Last, I would like to thank my family who have always been present giving me the stability and security, and Mirko for the example of his endless support and patience ensuring that I could pursue the research I love.

I am beyond words grateful.

I. Introduction

1.1 Area of research: bioarchaeology and the concept of 'stress'

Bioarchaeology is a relatively young research field that emerged during the 1960s from the application of skeletal biology to the paradigms of American processual archaeology (i.e. the New Archaeology) and cultural ecology (Buikstra 1977; Armelagos 2003). By adopting a biocultural perspective (Baker and Agarwal 2017), bioarchaeology – the discipline studying the human skeletal remains of the past – promotes a contextualisation of human skeletal and dental remains (i.e. the biological data) to improve our understanding of past populations, behaviour, adaptability, health and death. The biocultural perspective considers humans as both biological and cultural beings in which cultural influences can affect the biology of the human body in observable ways; moreover, the biocultural approach evaluates how culture interacts with the environment (Stinson *et al.* 2012). As pointed out by Agarwal and Glencross (2011: 1), 'the duality of the skeleton as both a biological and cultural entity has formed the basis of bioarchaeological theoretical inquiry'.

Bioarchaeology is a vibrant and interdisciplinary field of study, which encompasses multiple disciplines such as archaeology, human osteology and social theory, aimed at placing past communities in their biological, cultural and environmental context. The methodological approach of the bioarchaeology research field relies on the emphasis given to the integrative analysis of human remains within their context, including the archaeological, socio-cultural, and political aspects as well as the environmental contingency in which the ancient populations lived (Sheridan 2017). The consistency of bioarchaeology lies in its multi-scalar approaches, which embrace the use of advanced techniques such as molecular and chemical analysis, alongside ecological, ethnographic, and historical perspectives (Larsen 2018). Bioarchaeology investigates issues related to demography, spatial organisation, epidemiological transitions, human ecology, health conditions, socio-political changes, economic strategies, variation in resources access and social theoretical approaches to the understanding of how people experienced an array of circumstances over the course of their lives. The various components of the discipline can thus be summarised in the 'bioarchaeological model' illustrated in Figure 1, in which material culture is associated with skeletal remains to create a timeline for the ecology of health.

The model underscores how bioarchaeology must incorporate the analysis of skeletal remains within an archaeological, socio-economic and historical framework. In fact, the core of bioarchaeological research is the relationship between bone biology and the human behaviour, with special attention to

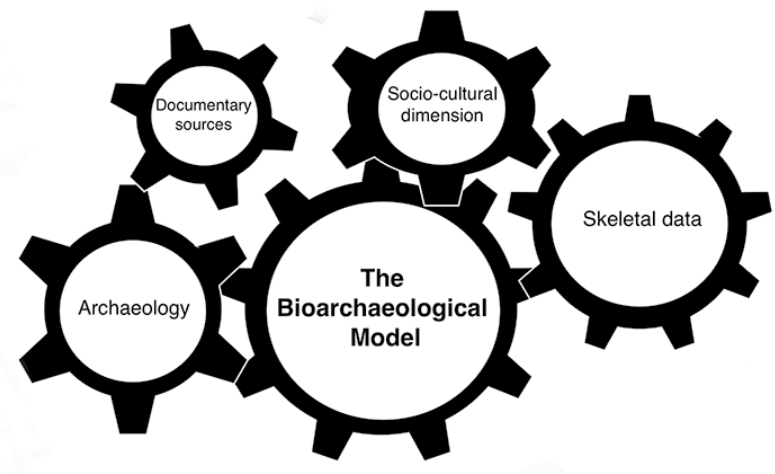

Figure 1. The Bioarchaeological model combines information from the biological and social sciences for a more holistic reconstruction of the past (Source: Author).

the effects of environmental influences on health and living conditions (Larsen 2015). The duality of osteoarchaeological remains as both biological and cultural entities represents the basis of social theory (Armelagos 2003; Buikstra and Beck 2006), the objective of which is to provide a reconstruction of the social identity based on sex, age or health in the past (Knudson and Stojanowski 2008; Sofaer 2006). The inclusion of social theory within the bioarchaeological model aims to overcome the traditional binary perception of biological data and material artefacts and to consider human remains as a biological and cultural phenomenon (Sofaer 2006).

Archaeological human skeletal collections provide a unique resource to understand the relationships between human culture and biology, including the study of disease dynamics across space and time. In this context, a focal point of bioarchaeological research is the investigation of stress indicators or markers in human skeletal remains in relation to adult health. As such, 'stress' is a fundamental concept which must be clarified for the purposes of this study. The word 'stress' is used in physics to refer to the interaction between a force and the resistance to oppose that force. Hans Selye, a pioneering Hungarian-Canadian endocrinologist known as the father of 'stress research' first included this term in the medical lexicon. He conducted several scientific experiments, postulating the importance of neuroendocrine mechanisms in the development of stress response. According to the early definition given by Selye, stress is 'the non-specific neuroendocrine response of the body' (Selye 1936; 1950a; 1950b), in which the stress response is induced independently of the nature of the stimuli. Later, he preferred to eliminate the word 'neuroendocrine' as he realised that almost every other vital system (e.g. cardiovascular, renal and pulmonary) was involved beyond the neuroendocrine system.

During his experiments on rats (1936), Selye showed that a diverse range of stressors including colds, injuries and the administration of chemical substances led to stereotypical physiological and hormonal processes that he called 'general adaptation syndrome' (GAS syndrome) and that he defined as the 'ability of living organisms to adapt themselves to changes in their surroundings' (1950a: 1383). This syndrome develops in three stages, i.e. alarm reaction, stage of resistance and stage of exhaustion (Selye 1950a; 1950b); stress response concerns the physiological mechanisms whose manifestations are primary hormonal responses produced by the adrenal cortex and the secretion of the adrenocorticotrophic hormone (ACTH) (for a review of Selye's works, see Szabo *et al.* 2012). In his researches, Selye neglected the study of specific disease signs and symptoms, choosing to focus purely on the patient's universal reactions to maladies, thus emphasising non-specificity as the main characteristic of stressors, i.e. various agents/factors causing stress as response (Selye 1950a; 1956; 1976).

Over time, other different definitions of stress were proposed by Selye in his works, identifying it as 'not a specific reaction' (1956: 54) or the 'nonspecific response of the body to any demand' (1976: 74). Although Selye dedicated his entire scientific career to providing proof of the importance of neuroendocrine mechanisms through the publication of papers and books, the major dilemma was the incapacity to give a univocal definition of stress. Non-specificity of Selye's definition of stress was subjected to criticism; therefore, the concepts of stress and stress response have varied in form and context throughout the decades with the contribution of other researchers who have attempted to narrow these notions and to make their definition less nuanced. In the 1970s, medical researchers (e.g. Mason 1971; Lazarus 1976; Cox 1978) argued against the GAS proposed by Selye, as it seemed to describe the response of an individual to stress in a too superficial manner. According to these authors, the psychological component and its impact were not taken into account in the physiological stress mechanism of an individual.

It is well known that the word 'stress' has become highly ambiguous and colloquial over the years and alternative terms have been proposed by McEwen (1998) and McEwen and Wingfield (2003) in an attempt to reinterpret Selye's concept of stress. However, new definitions such as 'allostasis' and 'allostatic load' (i.e. the adaptive processes that maintain homeostasis through change) have been criticised by Dallman (2003), who still preferred the widely used terms 'stressor' (stimuli which evoke physiological stress) and 'stress responses' (changes in the brain and body that occur as a consequence of persistent stress) (p. 18). Further efforts in the definition of stress have been made by Romero *et al.* (2009), even though they admit that it is a highly complex concept, with many different meanings pooled together, and even resulting in vulnerability to a charge of circularity (Romero *et al.* 2009). The lack of an unequivocal definition of the concept of stress is somehow connected to the fact that the term 'stress' incorporates three meanings: a) stimuli that cause a stress reaction; b) the physiological response to stimuli; and c) the pathological consequence resulting from an overstimulation of the natural physiological response.

Romero *et al.* (2009) developed a new model, defined as the 'Reactive Scope Model', in which the concepts of homeostasis, allostasis, and stress are integrated to understand different reactions to stressors (Figure 2).

This model presumes that hormonal, behavioural, and physiological mediators exist at four levels of activity. The first two levels form the normal reactive scope of

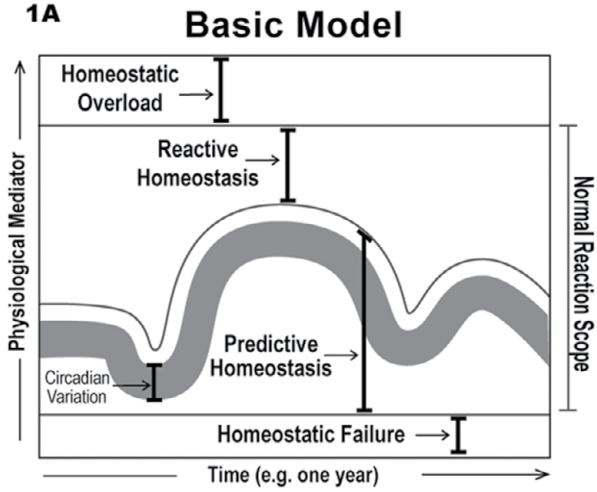

Figure 2. The Reactive Scope Model proposed by Romero *et al.* 2009 (reproduced with permission 4950621142886, Elsevier)

the organism. In particular, 'predictive homeostasis' is concerned with normal daily and yearly variations of the mediators (Romero *et al.* 2009), while the second level, 'reactive homeostasis', refers to the necessary reaction to abnormal environmental stressors (Romero *et al.* 2009). The other two levels of activity are categorised as pathological. 'Homeostatic overload' has been defined as the range of allostatic responses in which symptoms of chronic stress manifest with a high intensity or prolonged duration (Romero *et al.* 2009), while 'homeostatic failure' occurs when a response is insufficient (Romero *et al.* 2009). Yet, as stated by Romero *et al.* (2009), the normal Reactive Scope model can vary 'between individuals and within a single individual in response to certain stimuli' (p. 380); therefore, when considering responses to stress in human skeletal remains, such concepts can be beneficial in gaining a deeper understanding of the osteological response.

In bioarchaeology it is necessary to consider stress response, the way in which it is determined and its severity, as well as the physiological changes that might occur in relation to differing levels of stress response. It is clear that individuals are characterised by different levels of susceptibility or frailty and these might change over their lifespan and might be influenced by different factors (e.g. environmental and nutritional). Indeed, understanding stressors involved in human-environment interactions is crucial to interpret health in past societies. Stress as a physiological disruption occurring from environmental circumstances that interfere with homeostasis can be considered the product of three main components: a) environmental constraints; b) cultural buffering system; c) host resistance. Stress models adapted for studies in bioarchaeology were first conceived by Goodman *et al.* (1984), revised by Goodman and Armelagos (1989) (Figure 3), and ultimately readapted by Klaus (2012) The common denominator of these models is that they aim to interpret human interaction with external stressors at an individual and a population level, with a focus on how this interaction was managed through cultural buffering systems. The ultimate goal is to assess global health outcomes.

The linkage between stress and health is hard to define. 'Health' is another concept the World Health Organization (WHO) defines as 'a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity' (WHO 1948).

As well expressed by Reitsema and McIlvaine (2014), although 'health' as a concept exists, the significance of 'healthy' is ambiguous, even more when this concept is considered in relation to past communities. Moreover, it is well-known that 'stress' and 'health' are not interchangeable terms in bioarchaeology (McIlvaine and Reitsema 2013). In an attempt to reconcile 'stress' and 'health', Reitsema and McIlvaine (2014) thus suggest considering that 'physiological changes in the body as a result of stress are unhealthy' (p. 181). In these terms, 'stress' appears to be a useful proxy to assess health conditions in skeletal assemblages; by accepting this view, what bioarchaeologists can gain are potential insights into the synergistic connections between physiological stress response and etiological frameworks, whether biological, nutritional, cultural (i.e. buffering systems) and psychological (Reitsema and McIlvaine 2014). However, as expressed by Temple and Goodman (2014), the association of the health concept with skeletal remains is problematic and should be reconsidered, since the term 'health' involves factors that cannot be read in the skeleton (see WHO definition). For this reason, bioarchaeological studies should consider that skeletal indicators of stress 'are not measuring health outcomes, but instead, evaluating stress[1] within a community' (p. 189) and, more specifically, that 'skeletal indicators of stress and disease represent disruptions to physiological homeostasis at particular points of development, but do not necessarily act as a cumulative health index' (p. 190). Further clarification on how stress should be considered in bioarchaeological studies has been outlined by Klaus (2014): 'the goal is to elucidate the interplay therein (i.e. in bioarchaeology), where stress and behavior interact with underlying biology, diet, ecology, and socio-political structures to disrupt biological functioning. Also, what probably best

[1] Throughout this current work the concept of 'stress' has been considered as a physiological disruption resulting in tangible traces in bones and in teeth, and resulting from cultural, environmental and nutritional constraints. Although not quantifiable in skeletal remains, even the psycho-social variables require consideration in the final contextualisation of stress indicators.

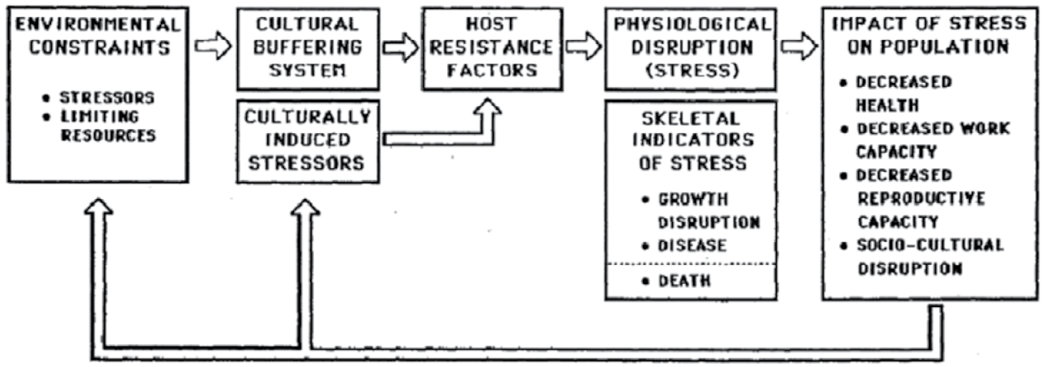

Figure 3. Stress model used for the evaluation of stress in skeletal populations (from Goodman and Armelagos 1989, reproduced with permission 4950640590243, Taylor and Francis)

describes stress-related phenomena is not homeostasis. More complete and dynamic understandings emerge from the concepts of allostasis [...]' (p. 295).

1.2 Bioarchaeological literature on stress markers and analysis of transition periods in the Italian agenda

Following well-developed research agendas on stress in other disciplines, most notably psychology and physiology as reported above, the 1980s have witnessed an increase in research on stress in physical anthropology. One of the most ground-breaking works was the volume *Paleopathology at the origins of Agriculture*, edited by Cohen and Armelagos (1984), which aimed to understand scientifically the role of stress in ancient populations by considering biological anthropology and cultural components as a whole. Osteological collections coming from various geographical areas were collected into this first comprehensive volume, which addresses how adoption and the intensification of agriculture impacted populations lifestyle and health in North America, Eastern Asia and the Levant. Four aspects were primarily dealt with: adoption of a population perspective, intrapopulation comparison over time, perception of cultural factors (social organisation, economy, ideology) able to influence the pathologic process and assessment of multiple stress markers. After this comprehensive synthesis, a large body of literature concerning the effects of socio-cultural factors on Pre-Columbian skeletal collections has been generated in the North-American bioarchaeological tradition (e.g. Goodman *et al.* 1984; Goodman *et al.* 1988; Buikstra and Milner 1989; Armelagos 1990; Milner 1992).

The project 'The Backbone of History: health and nutrition in the Western Hemisphere' (Steckel and Rose 2002a) brings together a database of 12,520 individuals, mostly Native Americans, alongside small subsamples of Euro-Americans and African Americans who lived between 4000 BC and the early 1900s. The aim of this large dataset is to study long-term trends in health by considering eight stress indicators: stature, oral pathologies, osteoarthritis, enamel hypoplasia, *cribra orbitalia*, porotic hyperostosis, trauma lesions and periosteal reactions. The distribution of stress markers is correlated with environmental factors such as settlement, topography, and substance economy, thus reflecting a relationship between ecology and past communities as conceptualised in medical anthropology of living populations (McElroy and Townsend 1996; 2009; 2015). The framework in which medical anthropology operates is a multidisciplinary field which integrates integration anthropology, ecology, and medicine to interpret how environmental and cultural contexts influence human health, both in small and more complex societies. The approach of medical ecology is also useful to understand the dynamics of the past, as the ancestors experienced comparative issues in terms of food strategies and population growth, alongside challenging environments (McElroy and Townsend 2009; 2015).

As the scope of this Introduction section is to provide a general overview of the major contributions within the field of stress research in bioarchaeology, it is important to note that the European tradition displays a paradigm shift on the specific topic of stress markers and health conditions by using a multi-temporal sequence. In northern Europe,[2] the British academic tradition reached a milestone with the work of McWhirr *et al.* (1982), whose investigations were focused on the single Romano-British site of Cirencester in Gloucestershire, and with that of Molleson (1993) dedicated to the Romano-British archaeological site of Poundbury Camp (3rd-5th centuries AD) in Dorset.

[2] A subregion geoscheme for Europe was created by the United Nations (UN), which defined northern Europe as composed of Scandinavia, the Baltic countries, the UK, Ireland, northern Germany, northern Belarus, and northwest Russia. Southern Europe was defined as consisting of the Iberian Peninsula, Italy, and the Balkan Peninsula (from United Nations 1999).