A Biocultural Study of the Populations of the Lower Pescara Valley and Its Hinterland: Health, Diet, and Identity in the 6th-4th c. BC in Abruzzo (Italy)

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A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

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May 2021

Abstract

This thesis explores the biological and socio-cultural variability in the populations inhabiting the hinterland and the lower Pescara valley during the 6th-4th centuries BC. These populations, also called Vestini by Roman and Greek historians, were organised in groups of villages, and they were involved in exchange networks with the surrounding cultures. Aside from the archaeological evidence, very little attention has been focused on the human element, on daily practices in life and in death, and on the ways in which these people understood and expressed who they were.

This dissertation, therefore, seeks to determine whether there were differences in diet, health, and identity among different populations' groups in this region. If differences were found, another aim was to understand how they differed and what inferences could be made to explain the possible reasons for such variability. The research takes a biocultural approach, employing osteological analysis, dental microwear and isotope analysis, for a simultaneous examination of multiple markers of physiological stress and disease, diet indicators and mobility. This, then, paired with an evaluation of funerary customs and material assemblages in burials, provides a multifaceted image of the individuals' life history. Five cemeteries are included in the study: Loreto Aprutino-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera, Pescara-Ex Gesuiti, and Nocciano.

Despite limitations due to the small sample size, differences in health and diet are clearly present within and across the cemeteries. Potentially non-local individuals are identified at Loreto Aprutino-Cappuccini. Subtle differences in funerary practices are noted among the cemeteries, but primarily and interestingly between the hinterland and the coastal area. In light of these biological and cultural observations, this investigation into the populations settled in the hinterland and the lower Pescara valley in Abruzzo, can be used as a first step towards a greater understanding of the life and death of small Italic communities in the 6th-4th centuries BC.

Acknowledgements

This dissertation would not have been possible without the support of numerous individuals. I would like to express my sincere gratitude to may supervisors, Dr Pia Nystrom and Professor Maureen Carroll for their consistent support, guidance, and encouragement through the whole period of my PhD.

I would like to thank the Regional Board of Archaeology (*Soprintendenza Archeologia Belle Arti e Paesaggio per le Provincie di Chieti e Pescara, sabap-ch-pe*) and in particular functionary archaeologist Dr Andrea Rosario Staffa for the permission to study the skeletal human remains and for allowing me to perform destructive analysis on the skeletal collection of the Loreto Aprutino-Cappuccini cemetery. Thanks to Dr Ruggero D'Anastasio and the archaeologist Paola Di Tommaso for helping me in retrieving the skeletal collection and thanks to Franca Nestore for being always present when needed.

A special thank goes to the Fondazione Pescarabruzzo (Pescara), the Banca di Credito Cooperative BCC of Loreto Aprutino, the Musei Civici di Loreto Aprutino, the town council of Loreto Aprutino and the major Gabriele Starinieri for funding part of this research. I thank Lorella Romano the school principal of Loreto Aprutino for kindly providing the room to carry out the osteological analysis of the skeletal remains.

I would like to thank for the strontium, carbon and nitrogen analysis: Dr Silvia Valenzuela Lamas (CSIC, Archaeology and Anthropology. Milá i Fontanals Institution (IMF-CSIC), Barcelona) for the technical assistance and for sampling the materials for the stable isotope analyses. I thank Dr Marco Ferrante (TRACE technology) for carrying out strontium isotope analysis. I thank the Associate Professor Carmine Lubritto (Univerità degli Studi della Campania "Luigi Vanvitelli") for performing stable isotope analysis. A special thank goes to Dr Maura Pellegrini for the assistance and advice with stable isotope analyses.

I thank for the dental microwear textural analysis: Dr Christopher W. Schmidt (Department of Anthropology, College of Arts and Sciences University of Indianapolis) who kindly carried out the microwear analysis and Dr Patrick Mahoney (School of

Anthropology and Conservation, University of Kent) for the assistance during the dental casting.

During my time in Sheffield I was fortunate to rely on the support and friendship of many people. My deep thank goers to Laura, Miguel and Becky for listening and encouraging me during my worse days and, in particular, for reading almost all the chapters of my thesis. I thank Giada for her constant moral support.

A big thank you goes to my family for always being present, supportive, and for believing in my potentials. Finally, my deepest thank goes to Valentina, my partner, without her constant support, love, presence, and encouragement all this would not have been possible.

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Chapter 1 Introduction

1.1 The Populations of the Lower Pescara Valley and Its Hinterland: General Introduction

The present study focuses on a population known as the Vestini through historical sources who inhabited the hilly area from the Apennines to the Adriatic coast (Vestini transmountain) in Central-South Italy during the 6th-4th centuries BC (Pliny, *Natural History* 3.107). This period was characterised by intense political and cultural transformations that saw the creation of new exchange networks along the Adriatic coast, increased warfare, the development of semi-autonomous city-states, and changes in socio-political power (Acconcia and Ferrari, 2020). Such political and cultural changes, along with environmental factors, may have an impact on the health status of individuals and may be reflected in the funerary practice of a population. The present thesis provides an insight in the health, diet, identity and mobility of the populations inhabiting this part of Abruzzo through the combined analysis of the human remains and associated funerary practices.

The Abruzzo region is characterised by a varied morphology with hills, valleys, and the Adriatic coastline that define the eastern sector of the region, while the Apennine mountains and highlands define the western one. Archaeological surveys of the whole region returned, to date, a large number of funerary sites dated from the Iron Age to the Roman period. Many of the cemeteries retrieved in the mountainous area, such as the cemetery of Fossa, were largely excavated and studied in past and recent years (Cosentino *et al.*, 2001, 2003; D'Ercole and Copersino, 2003; D'Ercole and Benelli, 2004; Sparacello *et al.*, 2014; Weidig, 2014; Menozzi and Acconcia, 2017). Only limited studies were conducted, however, in the area stretching from the Gran Sasso massif and the Adriatic coast (transmountain). Although several cemeteries have been excavated, the research on the populations inhumed in this area is still at an early stage (de Pompeis and Paolini, 1980; Staffa, 1998, 2000, 2001, 2003a, 2003b; Papi, 2014; Staffa and Cherstich, 2020).

The current understanding of the transmountain populations is rather basic, and very little attention has been paid to the human element, such as daily practices in life and the treatment of the deceased, and the ways in which they understood and expressed who they were. More can be understood about health, diet and identity, as well as about the changes occurred through the various stages of life of individuals, by carrying out systematic analysis of dental and skeletal remains, and of grave goods. Moreover, the investigation of the life histories of individuals and populations, intended as the reconstruction of specific aspects of an individual's life throughout time, is also becoming more efficient. The emergence of new advanced techniques, such as 3D dental microwear texture analysis, isotope analysis and ancient DNA analysis is facilitating this type of reconstruction. These analytical techniques provide significant insights to understand measurable variations at the individual level. However, the individual's variation can only be understood if contextualised within its cultural context and when concepts such as age identity and gender identity are taken into consideration during the interpretation of data (Zvelebil and Pettitt, 2008; Zvelebil and Weber, 2013; Hosek and Robb, 2019; Robb, 2019). Hence, conducting a study where both the overall context of a site (extrapolated from the funerary practices) and the individual remains are considered is crucial to suggest convincing new hypothesis regarding the life of a population. These considerations are also valid for the pre-Roman populations of Abruzzo.

Most of the information on the dietary habits of these populations, for example, comes from literary sources, and only limited archaeological or bioarchaeological research has been conducted on this and other related topics. This thesis, therefore, aims to provide initial evidence for the understanding of the primary source of subsistence of these communities by studying burial evidence. The cemeteries under investigation were part of extensive archaeological excavations which took place in Abruzzo from the second half of the twentieth century. These cemeteries were excavated within the Pescara District, in an area stretching from the hinterland and the lower Pescara valley and they provided the material for a critical understanding of these neglected population groups.

Five cemeteries were included in this research, three of which contained both human skeletal remains and grave goods: Loreto Aprutino-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera. The remaining two cemeteries, Pescara-Ex Gesuiti and Nocciano, provided information on the funerary context and the grave goods, though the skeletal remains were not available for osteological analysis. Osteological methodologies were used to reconstruct the demographic profile of these communities and their health; furthermore, dental microwear surface texture analysis was employed to investigate differences in diet within and between the cemeteries. Analyses of carbon, nitrogen, and strontium isotopes were included in the study to investigate diet and mobility patterns in the Loreto Aprutino cemetery. In addition, funerary evidence was used to determine the cultural and socio-political organisation of this population, reflected by burial typology and grave goods. The simultaneous examination at individual level of the skeletal data, paired with funerary and material evaluations, provide a multifaceted image of the populations inhabiting this region of Italy.

To the best of the author's knowledge, life course studies have not been conducted in Italy and, indeed, not in Abruzzo. This thesis, therefore, represents the first work that seek to implement a biocultural study, in line with the life course approach, for the study of a pre-Roman population. It provides an insight in the diet, health, identity and mobility of the individuals who inhabited the hilly area at East of the Gran Sasso massif and the lower Pescara valley, through the combined analysis of human remains and the associated funerary practices.

1.2 Aims and Research Questions

This thesis aims to explore biological and socio-cultural variability in the populations inhabiting the hinterland and the lower Pescara valley in Abruzzo, to determine whether there were differences in health, lifestyle and gendered behaviour among different groups. It also aims to understand potential differences and to offer possible explanations for such variability. The main objectives are summarised as follows:

1) To provide, for the first time, a demographic profile of the populations buried in the Loreto Aprutino-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries.
2) To examine whether there were differences in health within single populations and between the populations of the hilly area (Loreto Ap.-

Cappuccini and Moscufo-Via Petrarca) and those on the Adriatic coast (Spoltore-Quagliera).

3) To determine whether there were differences in diet within single groups and between the populations of the hilly area (Loreto Ap.-Cappuccini and Moscufo-Via Petrarca) and those on the Adriatic coast (Spoltore-Quagliera).
4) To evaluate patterns of mobility among the individuals inhumed in the cemetery of Loreto Aprutino.
5) To examine whether there were differences in the existence and expression of gender and age identity, and social status in these same populations.
6) To provide an overall understanding of population health, society and culture among the communities inhabiting the region east of the Gran Sasso, in order to prepare the way for future investigations.

1.3 Thesis Outline

Chapters 2 and 3 provide background information to place the study in context. Chapter 2 is divided in two broad sections, the first one providing an overview on the definition of health and the issues regarding the interpretation of health in past populations. It describes the various indicators of oral and skeletal health, and it provides information on dental microwear texture analysis and stable isotope analyses for the reconstruction of diet and mobility. Section 2.2 discusses the current issues on how identity can be expressed in archaeological contexts. Chapter 3 includes a brief overview of the major funerary contexts excavated both in regions neighbouring with Abruzzo and in Abruzzo itself (sections 3.1.1 and 3.1.2), to offer a wider perspective for understanding the cemeteries analysed in this thesis (Nocciano, Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, Spoltore-Quagliera, Pescara). This chapter (section 3.2) also gives an overview of bioarchaeological studies conducted, mainly in central Italy, in recent years, which highlight the lack of biocultural studies and the need for more. A detailed analysis of five major cemeteries excavated in central Italy, with a focus on the analysis carried out on the skeletal remains and the grave goods associated with them, follows in section 3.3. Chapter 4 describes the five cemeteries investigated in this research. Chapter 5 provides information on the materials selected for the present study, on the methods applied to assess pathological conditions on the osteological collection, and on the methods used to collect data; it also summarises the information on the funerary context. Chapter 6 presents the results of the demographic, palaeopathological, and statistical analyses, as well as the results obtained from dental microwear and isotope analyses. Chapter 7 presents the results concerning the funerary practices adopted by the individuals buried in the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, Spoltore-Quagliera, Pescara-Ex Gesuiti, and Nocciano cemeteries. In Chapter 8 the points of intersection between biological and cultural data are discussed, and an analysis through different scales, at the level of group of cemeteries, individual cemeteries, and individuals, is given for the selected research themes. Chapter 9 presents the overall conclusions and provides suggestions and ideas for potential further research on these studied populations.

Chapter 2 The Human Body as Connection of Biological and Sociocultural Bodies

2.1 The Biological Body: Health and Disease in Past Human Populations

Scholars agree on considering the human biological body and the surrounding environment as two indiscernible aspects when studying health in modern and past societies (e.g., Scheper-Hughes and Lock, 1987; Bush and Zvelebil, 1991; Dufour, 2006) Certain biological characteristics like age, sex, stature, and pathology have an impact in the way on which people interact and are perceived by other members of society. Therefore, the application of an integrated approach in the study of health is pivotal to understand the human response variability to a specific environment (Scheper-Hughes and Lock, 1987).

2.1.1 Definition of Human Health and Disease

Health is a fundamental condition of human beings and it is culturally determined. Due to this, problems appear when trying to define the term health (Brüssow, 2013). The current definition formulated by the World Health Organisation (WHO) in 1946 considers health as "a state of complete physical and social well-being, and not merely the absence of disease or infirmity" (WHO, 1946, p. 1). This definition of health has been criticised by contemporary scholars, since it is difficult to evaluate and measure the 'complete' well-being of individuals, this being a utopian condition, static and difficult to achieve (Huber *et al.*, 2011; Leonardi, 2018). It has been argued that the WHO definition does not fit within the contemporary state of well-being. In fact, it does not consider the increasing longevity in the modern age as well as the number of individuals experiencing long-term diseases (Huber *et al.*, 2011; Leonardi, 2018). Moreover, according to this definition a large proportion of current populations would be considered unhealthy. As a result, Huber *et al.* (2011, p. 2) formulated health as the "ability to adapt and to self-manage" within the three main health domains: physical, mental, and social. In addition, Leonardi (2018) considered health as something which is created by the interaction of individuals or groups in different social contexts.

Leonardi (2018) stated that different situations cannot be covered by a single definition of health, therefore a specific context requires a specific definition. Several researchers agree on the need to have a more dynamic formulation of health based on "the capability to cope with and to manage one's own malaise and well-being conditions" (Leonardi, 2018, p. 742). He continues saying that "this definition encompasses both individual and social variables, focusing on individual responds to environmental events" (Leonardi, 2018, p. 742). The proposed definition would overcome the utopian idea of health expressed by the WHO, although it presents problems regarding the measurability of health. Hence, it is difficult to define health in living people and it is even more difficult when past populations are considered, especially because many mental states and participation in social activities cannot be assessed in deceased individuals (DeWitte and Stojanowski, 2015).

Disease, like health, is difficult to define (Smith, 2002). The *Cambridge English Dictionary* defines it as: "(an) illness of people, animals, plants, etc., caused by infection or a failure of health rather than by an accident". Scully (2004) stated that the definition of disease given by medical dictionaries is not exhaustive. She underlined the fact that the notion of disease varies according to cultural context, sex, gender, social status, and time, and it cannot represent an opposite condition to health (Scully, 2004). In bioarchaeology health and disease are studied within a biocultural framework, placing emphasis on the connection and interrelation of biological, environmental, and cultural systems (Goodman *et al.*, 1988; Bush and Zvelebil, 1991; Dufour, 2006). The study of health and disease on past populations requires a question and hypothesis-driven analysis, and a multidisciplinary approach.

2.1.2 Human Response to Disease

The response of the human body to disease varies according to factors that involve biology and environment (Ortner, 2003). Genetics, for example, plays a major role in resistance to disease and is considered an important factor of human adaptation (Ortner, 2003). In addition to the individual genetic inheritance, culture has an important role with regard to disease; as it can act as a buffer either minimising the effect of disease on people or triggering it (Ortner, 2003; Temple and Goodman, 2014).

To diagnose evidence of disease on bones, it is necessary that the disease reached its chronic stage. This means that the immune system of a person resisted the acute stages of the disease, leading to a long-term survival with it (Ortner, 2003; Roberts, 2012). As a consequence, individuals that did not show skeletal evidence of disease were not necessarily healthy; this is the "osteological paradox" which is fully discussed below (Section 2.1.3). Ortner (2003, p. 110) listed three possible factors which can leave no evidence on bones: " (1) a person may die of a disease that does not affect the skeleton, (2) death can occur in a disease that has the potential of causing skeletal lesions or abnormalities before these pathological conditions develop, and (3) the immune response of the exposed host may eliminate or control the pathogen before skeletal disease can occur". Biochemical methods, such as the examination of ancient DNA and ancient proteins from bone and dental calculus (Bouwman *et al.*, 2012; Warinner *et al.*, 2014) are the only ways in which these conditions can be evaluated in bioarchaeology. These conditions cannot be evaluated However, Roberts (2012) stated that caution should be taken when interpreting data from biochemical analyses, since the presence of aDNA of pathogens such as *M. tuberculosis* or *M. leprosy* in bone and calculus does not necessarily mean that the person suffered the disease, but rather could have been a carrier of the pathogen.

Observable variations from the deviation from normal growth and appearance of bone are evaluated as evidence of disease in palaeopathological studies. In a normal condition, bone undergoes phases of bone formation and destruction as process of bone remodelling governed by osteoclasts and osteoblasts cells. When the equilibrium is affected by disease, then abnormal changes of bone morphology (abnormal bone formation and abnormal bone destruction) can occur (Ortner, 2003; Roberts, 2012). Pathogenic organisms create conditions that can stimulate or inhibit the formation or destruction of bone cells (osteoclasts and osteoblasts). The distribution of the changes might vary according to the specific disease, however different diseases can produce the same skeletal response and can affect the same bones for example leprosy, scurvy, and tuberculosis which all affect femora, tibiae and fibulae (Ortner, 2003; Roberts, 2012). This makes the diagnosis of specific diseases difficult in most cases. Furthermore, morphological changes to the bone can be caused by post depositional environmental conditions, known as pseudo-pathologies (Fornaciari and Giuffra, 2009; Waldron, 2009).

2.1.3 The Osteological Paradox

Wood *et al.* (1992) introduced the principle of the 'osteological paradox' to overcome issues in the analysis of pathological features on skeletons of past populations. This article challenged the prior binary conception that individuals with no sign of bone remodelling/bone pathology were considered healthy, while individuals with bone pathologies were unhealthy. Wood *et al.* (1992) stressed that individuals who lived long enough to produce skeletal lesions were healthier than the ones without lesions. Skeletal lesions take time to form; therefore, individuals with these lesions had an immune system strong enough to tackle the disease, surviving longer than the ones with a weaker immune system who died before skeletal lesions could form. Three main conceptual issues, which limit the evaluation of health status and adaptation at a population level in bioarchaeology, were outlined in Wood *et al.* (1992) paper. Those were further re-examined by DeWitte and Stojanowski (2015). The issues are: 1) demographic nonstationary, which refers to growth or decline of a population as a consequence of periods of migration or changes in mortality and fertility. One of the main problems of a nonstationary population is the underestimation or overestimation of the life expectancy within the population, even if the mortality rate does not change over time. 2) Selective mortality, connected to the heterogenous frailty, refers to the concept that individuals expressing high frailty at a given age may have more chances of dying at that age compared to other individuals. However, the death of an individual at a certain age does not mean automatically that the entire population will die at that particular age. 3) Heterogeneous frailty, which reflects to the fact that it is unlikely that two individuals have the same risk of dying at a precise age.

The risk of death varies among individuals because of biological, environmental or nutritional differences (DeWitte and Stojanowski, 2015). Wood *et al.* recognised that the failure to overcome these problems lead to a meaningless interpretation of demography and health of past populations. According to DeWitte and Stojanowski (2015), Wood *et al.* highlighted the importance that the cultural context may have when analysing health.

In addition, the authors suggested that the role of the cultural context should be better understood for making sure that selective mortality and heterogeneous frailty do not have a major effect when patterns of health are compared.

The "Osteological Paradox" generated a mixed reaction among scholars (DeWitte and Stojanowski, 2015). Many agreed that problems related to selective mortality and heterogeneous frailty in the study of palaeopathology were still not fully addressed (Eisenberg, 1992; Jankauskas and Cesnys, 1992; Lukacs, 1992; cited in DeWitte and Stojanowski, 2015), while other scholars challenged the relevance of the osteological paradox as it did not go far enough in addressing the existing issues related to sex and age estimation techniques and the binary concept of healthy and unhealthy (Goodman, 1993; Cohen, 1994; cited in DeWitte and Stojanowski, 2015). For example, Goodman (1993) stated that it was possible to overcome the issues related to the Osteological Paradox by acquiring multiple evidence when study pathological conditions in past population, and considering cultural and biological processes as well as archaeological and historical contexts. These criticisms were later tackled in the comments published by Wood and Miller (1994). In DeWitte and Stojanowski's (2015) review the main concern regarding the Osteological Paradox was that many studies do not fully engage with the concept of the Paradox. The authors found that the Paradox is always cited in literature but rarely directly addressed. Collaborations between different disciplines and technological advances may help to better understand heterogenous frailty within a population. Specifically because it is possible to detect, with the use of biomolecule analysis, parasites and pathogens and examine their diverse distribution within the skeletal sample, as well as the relationship between nonaffected and affected individuals.

A biocultural approach to paleopathology has been proposed to overcome the issues related to the study of health and heterogeneous frailty in past populations, because it incorporates multiple lines of evidence when skeletal remains from archaeological sites are analysed (Bush and Zvelebil, 1991; Roberts, 2016). The aim of the biocultural approach is to clarify the dynamic interaction between individuals and their cultural, social and, physical environments as an intertwined matrix, and the role of health in this relationship (Bush and Zvelebil, 1991; Dufour, 2006; Zuckerman *et al.*, 2012). Under the holistic framework of biocultural studies, population and individual health can be better understood by utilising multiple methods including microwear texture analysis, stable and elemental isotope analysis, and ancient DNA.

2.1.4 Palaeodemography and Indicators of Stress and Disease on Dental and Skeletal Remains

2.1.4.1 Palaeodemography

Palaeodemography is the study of past human population dynamics and aims to determine variations in size, structure, and spatial distribution of populations derived from archaeological contexts (Hoppa and Vaupel, 2002; Chamberlain, 2006; DeWitte, 2018). Palaeodemography is influenced by changes on rates and levels of fertility, migration and mortality, all of which vary across age and sex categories as well as over time (Chamberlain, 2006; DeWitte, 2018).

Several assumptions must be made when a palaeodemographic study is conducted. The most important is the biological uniformitarian assumption (Howell, 1976). This assumption relies on the fact that the biological processes related to mortality and fertility in humans were the same in the past as they are in the present (Hoppa, 2002). Therefore, patterns of sexual dimorphism and age in individuals of the past are considered the accurate reflection of once living population, and were constant across different populations (Hoppa, 2002; Chamberlain, 2006). The uniformitarian process of a population has two implications. Firstly, it assumes that changes in human biological responses to the environment did not occur, which is not the case because sexual dimorphism and skeletal maturation have changed over time (Hoppa, 2002; Chamberlain, 2006). To overcome this assumption, Chamberlain (2006) suggested that the population under investigation should have specific standards for sex and age estimation. Secondly, uniformitarianism assumes that the development of human skeletal growth morphology does not vary across different populations separated in time and space (Hoppa, 2002). This issue is still unresolved, and a deeper understanding of biological processes of skeletal aging needs to be achieved to overcome errors in the aging criteria of skeletal remains (Bocquet-Appel and Masset, 1996; Lovejoy *et al.*, 1997).

Demographic models were calculated from the premise of a 'stationary' population model, as far as the biological uniformitarian assumptions are concerned. A stable population is closed to migration; therefore, its age-sex structure remains unchanged and it grows or declines at a constant rate (Acsádi and Nemeskéri, 1970; Wilson *et al.*, 1985; Hoppa, 2002; Chamberlain, 2006; Milner *et al.,* 2007). However, it is difficult to prove that a population was stable, and failure to meet this assumption can result to incorrect inferences about the associated population dynamics (Johansson and Horowitz, 1986; Wood *et al.,* 1992; DeWitte, 2018).

In archaeology several factors limit the accurate evaluation of the demographic profile of a population, specifically: small sample size, inaccurate, incomplete and biased data (Milner *et al.*, 2007; DeWitte, 2018). The main source of bias in palaeodemographic data is the low representation of infant and young individuals. This can occur because skeletal remains of infants and children are more affected by taphonomic changes, and because infants and young individuals are less easily recognised in a cemetery (Chamberlain, 2006). Taphonomy and inaccurate excavation and recovery of skeletal remains from a cemetery led to an overrepresentation of adult and old individuals creating a bias and lack of information for the population demographic profile (Chamberlain, 2006; Milner *et al.,* 2007). Moreover, theoretical and methodological problems, for example the accuracy in the estimation of age at death of old individuals and the sex estimation of infants and young individuals further contributed to palaeodemographic inaccuracy (Milner *et al.*, 2007; DeWitte, 2018). Newly developed age at death estimations methodology (Aris *et al.,* 2018) coupled with better understanding of skeletal pathologies distribution, isotopic analyses, and archaeological data contribute to increase the possibilities of a more precise paleodemographic analysis.

2.1.4.2 Stature and Body Mass Estimation

2.1.4.2.1 Stature Estimation

Skeletal growth and stature are closely related (Larsen, 1997). Growth as defined by Scheuer and Black (2000a, p. 4) indicates: "the progressive incremental changes in size and morphology that occur throughout the development of the individual". The pattern of growth is assumed to be linear from birth to adulthood, though there are two main developmental stages of rapid growth, the first one between 6 and 8 years of age and the second one at the adolescent spurt (the period where more height is gained). In addition, growth rate of female and male individuals varies (Scheuer and Black, 2000a; Waldron, 2009). Growth is regulated by genetic, nutritional, and environmental factors, and because of this, inequality in access to food resources, poor living and work conditions, and disease during infancy and childhood, can suppress growth and the attainment of full adult body size and height (Goodman, 1991; Steckel, 1995; Pinhasi, 2008). This relationship has been documented in modern (Bailey *et al.*, 1984; Perkins *et al.*, 2016) and past populations (Lewis, 2002; Mummert *et al.*, 2011; Sparacello *et al.*, 2017). Several studies have been conducted to understand the relationship between growth and stress conditions caused, in particular, by nutrition and infectious diseases (Pinhasi, 2008). Nutrition and infectious diseases appear to be correlated; hence growth stunting may be the result of a complex nutrition-infection system rather than a direct consequence of malnutrition or undernutrition (Martorell, 1989; Pinhasi, 2008). Larsen (1997) reported a decline in nutritional quality for maize consumers and a reduction in stature of 3% for adult females and 1% adult males (AD 1150-1550) compared with the prehistoric Georgia coastal farmers (pre-AD 1150). Similarly, a reduction in stature related to the shift to agriculture or agricultural intensification has been observed (Mummert *et al.*, 2011). While, genetic factors are important for the final height, nutrition plays a major role because individuals with poor diet do not achieve their genetic growth potential (Larsen, 1997). Changes in stature over time can be seen in a study conducted by Gianecchini and Moggi-Cecchi (2008) on past populations from central Italy. The results show a decrease in stature of both male and female individuals from the Iron Age to the Roman period, and an increase from Roman to Medieval period. They suggested that the decrease in body size during the Roman period could have been related to socio-economical changes and health. However, a detailed skeletal and archaeological analysis of those and other populations is necessary to be able to understand patterns and reasons of stature variation in past in Central Italy.

In practical terms, stature estimation in adult individuals is based on the measurement of the length of complete (Trotter and Gleser, 1952; Ruff *et al.*, 2012) or fragmented long bones (Bidmos, 2009; Fongkete *et al.*, 2016), or the measurement of total height of all skeletal elements (Fully, 1956). Several regression equations have been produced to calculate the stature according to sex and ancestry (Pearson, 1899; Trotter and Gleser, 1952, 1958; Formicola and Franceschi, 1996), hence appropriate regression formula should be selected in accordance with the studied skeletal materials to have a more accurate stature estimation (Giannecchini and Moggi-Cecchi, 2008; Roberts, 2012). Rates of growth can be observed from the measurement of the diaphyseal length of long bones in non-adult skeletons rather than stature (Hoppa, 1992; Danforth *et al.*, 2009; Cardoso *et al.*, 2014).

2.1.4.2.2 Body Mass Estimation

Body mass estimation, together with stature estimation, provides important information in the study of past individuals (Ruff, 2002). Body mass estimates vary according to nutrition, health, sexual dimorphism, and cultural and environmental factors (Ruff, 2002; Ruff *et al.*, 2012). Climate is one of the factors that has been observed to have a possible effect in determining body size variation between populations living in hot and cold climates (Ruff, 1994). Holt *et al.* (2018) studied individuals from several archaeological sites in France and Italy (from Iron Age to modern period) and found that there is a statistically significant difference in stature and body mass between rural and urban sites. Rural males were taller and heavier that urban males, while the females did not show a significant difference. They also found a sharp decline in body mass and stature in male and female individuals of the French-Italian samples from Mesolithic to Neolithic. Followed by an increase from Neolithic to Bronze Age and Iron Age times. This decrease in body mass and stature has been associated with a decline in nutritional and living conditions, as well as the rise in socioeconomic and status differentiation in Neolithic French and Italians individuals (Guidi and Piperno, 1992; Cunliffe, 1994; Sparacello, 2013; Holt *et al.*, 2018).

Estimation of body mass from skeletons has proven difficult, and accuracy in the methods is required (Lacoste Jeanson *et al.*, 2017). There are two approaches currently established for body mass estimation using postcrania: the "mechanical" method which is based on the relationship between body mass and dimension of weight-bearing skeletal element (femoral head breadth); and the 'morphometric' which is based on the evaluation of body mass from a function that combine stature and bi-iliac breadth (Auerbach and Ruff, 2004). The use of one approach over the other depends on the sample analysed. When stature and bi-iliac breadth can be measured, the morphometric method provides the most reliable body mass estimation for that sample. In contrast, when lacking skeletal elements for the morphometric method, the mechanical method (femoral head formulae) gives accurate results if appropriate formulae are chosen according to the size of the skeletal sample (Auerbach and Ruff, 2004).

2.1.4.3 Oral Health

2.1.4.3.1 Introduction

Many consider teeth the most important parts of human anatomy for palaeopathological and osteological studies. The reason for this is that they interact directly with the external environment and are more resistant than bones to chemical and physical destruction (Ogden, 2008; White *et al.*, 2012). The main components of teeth are enamel, dentine, pulp cavity and root canal (Ortner, 2003) (Figure 2.1).

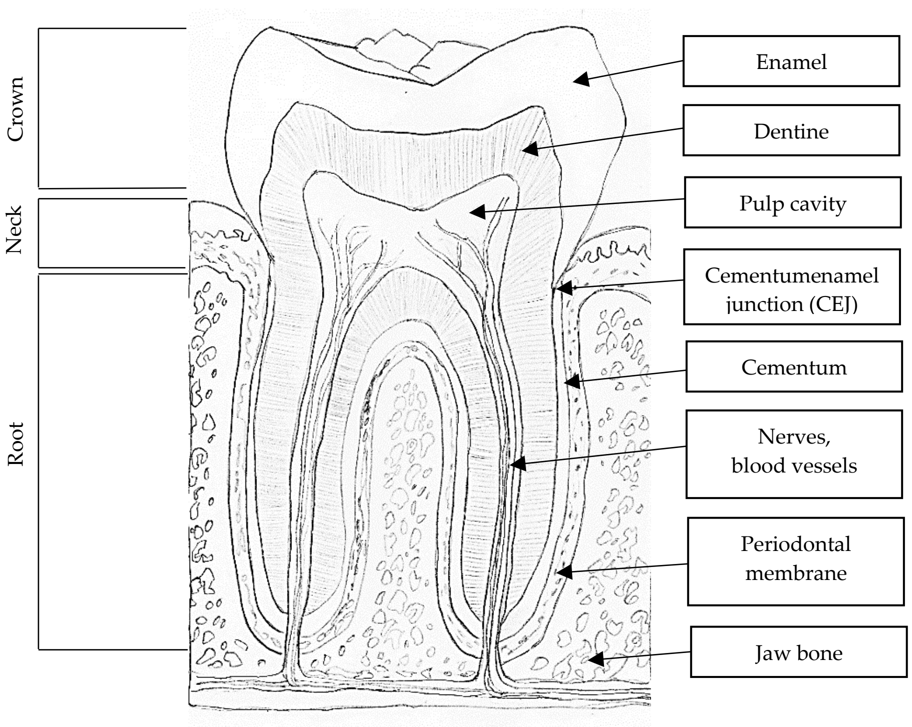

Figure 2.1 Dental structure anatomy. Drawn by the author.

The enamel is the hardest part of the tooth and covers the tooth crown. It comprises mainly of a mineral component (96%) and water; it has no cells and no vascular system. Dentine is a tissue that has a mesenchymal origin, forms the tooth root, and supports the tooth crown. Dentine is principally made of inorganic components (70%), but also of organic materials (20%) and water (Ortner, 2003; Fornaciari and Giuffra, 2009). Enamel and dentine grow in a rhythmical way and the disturbance of this rhythm by external factors can result in defects visible on the erupted tooth (enamel hypoplasia), useful to reconstruct the sequence of events during childhood (Hillson, 1979, 2014). Pulp cavity and root canal contain nerves, vascular supply, and pulp mesenchyme which produces odontoblasts that have a dentinogenetic function. The tooth is anchored to the alveolar socket by cementum and periodontal membrane (Ortner, 2003). Through the study of teeth is it possible to obtain information on the diet, oral health, stress factors of individuals and more generally, populations (Hillson, 1979; Fornaciari and Giuffra, 2009; White *et al.*, 2012).

2.1.4.3.2 Carious Lesions

Dental caries is a disease of infectious origin initiated by microbial activity on the tooth surface, which results in a progressive destruction of enamel and dentin (Ortner, 2003). The process of caries development can be considered as multifactorial since three factors should be present on tooth surface in order for it to be initiated: bacterial film (plaque), fermentable carbohydrates, and production of acid (Waldron, 2009). Bacteria in the plaque (*Streptococcus mutans* and lactobacilli) metabolise the fermentable carbohydrate producing organic acids that lower the pH of the mouth, leading to the demineralisation of the tissues of the tooth (Waldron, 2009). The development of carious lesions is very slow, and it is controlled by stages of demineralisation and remineralisation of dental tissues. Untreated caries may result in the loss of the entire tooth (Hillson, 1996; Ortner, 2003; Waldron, 2009).

Location of dental caries in archaeological samples is very informative because caries affect tooth surfaces in different ways and specific patterns of dental caries are produced in combination with mouth bacteria and diet. Therefore, different people might have a different response to carious lesions according to their food resources and biological conditions (Ortner, 2003). Research on dental caries in past populations has a long history. Several studies conducted on hunter-gatherer and agricultural populations, show that the frequency of caries was higher among agriculturists than hunter-gatherers as a result of a diet rich in carbohydrates in the former (Larsen *et al.*, 1991; Hillson, 1996; Larsen, 1997; Temple and Larsen, 2007). In addition, it was observed that the reduction rate of oral health was higher in women than men, and sex differences in dental caries prevalence was linked to women's fluctuation in hormonal levels, modification of the biochemical composition of the saliva during hormonal fluctuation, and pregnancy (Lukacs and Largaespada, 2006; Lukacs, 2008). For example, a higher prevalence of carious lesions in women was seen in a 6th-4th centuries BC. Samnite population from Molise (Petrone, 1994). Cucina *et al.* (2011), studying a prehispanic Maya population, stressed the importance of not considering food as the sole factor causing carious lesions, but rather the focus should be broadened to other aspects like socio-economic and cultural changes in the population, that can contribute to the decline of oral health.

The study of dental caries in skeletal remains is associated with several problems. The first one is purely taphonomic, post-mortem tooth loss prevents the observation of teeth affected by caries. The second problem is due to antemortem tooth loss; which might be the result of caries, but also of extensive wear and abscesses, which impede the exact evaluation of the tooth loss (Ortner, 2003; Fornaciari and Giuffra, 2009).

2.1.4.3.3 Periapical Lesions

Periapical lesions or abscesses are cavities present on the maxillary or mandibular bone, usually located at the apex of the tooth (Waldron, 2009). There are three types of periapical lesions: granulomas, cysts and abscesses (Ogden, 2008). Granulomas and cysts are cavities containing fluid and when pus forms in these cavities due to inflammation processes, they are named abscesses. Granulomas commonly develop into cysts and abscesses. An abscess in the acute phase can create a fistula on the bone surface and, through that, the pus is drained into the mouth or maxillary sinus (Fornaciari and Giuffra, 2009; Waldron, 2009). The most frequent cause of abscesses are caries and periodontal disease, and abscesses can be a source of tooth loss (Fornaciari and Giuffra, 2009; Waldron, 2009).

2.1.4.3.4 Dental Calculus

Dental calculus is the result of bacterial plaque mineralisation. The mineralisation occurs when the pH of the saliva increases producing an alkaline environment in the mouth. This induces the precipitation of the predominant calcium phosphate mineral salts from the saliva as a part of the bacterial plaque (Fornaciari and Giuffra, 2009; Waldron, 2009). Calculus can be supragingival or subgingival depending on where the deposition occurs, respectively indicating on the crown of the tooth or on the exposed root (Hillson, 1996; White, 1997). The formation of calculus is often related to diet (Hillson, 1979). It has been observed that when bacteria metabolise proteins, they produce alkaline waste products, whereas when carbohydrates are metabolised lactic acid products are obtained changing the pH of the mouth from alkaline to acid. Therefore, a diet high in protein increases the alkalinity of the oral environment allowing the formation and deposition of calculus on the tooth, since there are insufficient acid episodes that cause the demineralisation of the calculus (Hillson, 1979; Gualandi, 1992).

The relationship between dental calculus and dental caries is thus inverse, because the former depends on mineralisation, while the latter on demineralisation, although this relationship is not always maintained (Hillson, 1979, 2001; Waldron, 2009). Hillson (1979) stated that other non-dietary factors might determine the formation of calculus like poor oral hygiene, physiology, genetics and environment. Calculus is useful in bioarchaeology for several reasons among which there is the assessment and evaluation of the presence and degree of periodontal disease in ancient populations (Brothwell, 1981; Ortner and Putschar, 1985). Also, proteomic and DNA analyses of dental calculus provide evidence of environment, disease, dietary source of ancient populations, because calculi have the potential to preserve environmental bacteria species, pathogens and food-related proteins (Mackie *et al.*, 2017; Hendy *et al.*, 2018).

2.1.4.3.5 Periodontitis

Periodontitis is the advanced stage of the inflammation process which affect the gums: gingivitis (Ortner, 2003). Periodontal disease is characterised by the progressive resorption of alveolar bones and the periodontal ligaments which likely culminate in tooth loss in adult individuals (Ortner, 2003; Fornaciari and Giuffra, 2009). The aetiology of the periodontal disease is multifactorial, there is general agreement that calculus and bacterial plaque are involved in the inflammatory process, although other influencing factors may be represented by dental wear, caries, poor oral hygiene, physiological aspects, and metabolic problems (Hillson, 1986; Larsen, 1997; Ortner, 2003; Waldron, 2009). Diagnostic features for the evaluation of periodontitis comprise local and general resorption of the alveolar bone and considerable root exposure, as well as, evidence of bone remodelling such as pitting and new bone formation around the roots of affected tooth (Waldron, 2009). Bone loss can also be caused by other conditions, which may lead to a false positive diagnosis and overestimate the prevalence of periodontal disease in the studied individuals (Raitapuro-Murray *et al.*, 2014).

2.1.4.3.6 Dental Wear

Dental wear is the progressive loss of enamel and dentine as a result of the continuous contact between the occlusal and interproximal surfaces of teeth and between tooth-food-tooth during masticatory stresses (Ogden, 2008). Tooth wear can be the result of physiological or pathological factors, and because of its progressive process correlated with aging, it is used in bioarchaeology as a method of age at death estimation (Fornaciari and Giuffra, 2009; Forshaw, 2014). Abrasion, attrition, and erosion are the three forms of tooth wear: abrasion is caused by tooth to food contact or the contact between tooth and inorganic particles; attrition is the contact between teeth (abnormal occlusion, bruxism, abnormal tooth structure); while erosion is caused by chemical processes (Larsen, 1997; Soames and Southam, 2005). Food consistency and texture influence the severity of dental wear; studies show that populations relying on abrasive food have more advanced wear compared to those relying on soft-textured food and food preparation technology (Larsen, 1997; Masotti *et al.*, 2013; Mickleburgh, 2016). The relationship between diet and dental wear is extensively described in the subsection 2.1.5.1. Dental wear can be also caused by factors that do not involve mastication. These non-masticatory functions are associated with the use of teeth as a tool or third hand (Larsen, 1997). Presence of chipping, notching, lingual surface attrition of the maxillary anterior teeth (LSAMAT), and oriented grooves on dental surface of maxillary and mandibular dentition might be illustrative of the role of teeth in the practiced activity as a third hand (Molnar, 2008; Tanga *et al.*, 2016).

2.1.4.3.7 Antemortem Tooth Loss (AMTL)

Antemortem tooth loss (AMTL) is the ultimate condition reached by individuals affected by acute or chronic dental pathologies. It is difficult to identify the cause of antemortem tooth loss because all the dental diseases described above can lead to dental loss (Lukacs, 2007). Research on AMTL aetiology, prevalence and distribution in past populations highlighted that diet is a primary agent in AMTL, followed by sex differences (Larsen, 1997; Lukacs, 2007). The shift to agriculture had an effect in the rate of AMTL prevalence in prehistoric populations, which was higher in farmers than foragers groups (Cassidy, 1984; Patterson, 1984; Rose *et al.,* 1993). In terms of sexual dimorphism, most studies showed that women reported higher rates of AMTL that men (Fornaciari *et al.,* 1985; Al-Shammery *et al.,* 1998; Jurmain, 1990; Gualandi, 1992). The high prevalence of AMTL in women has been associated with sex-specific extra-masticatory activities (loss of anterior teeth), and hormonal fluctuation (Costa, 1980; Lukacs and Largaespada, 2006).

2.1.4.3.8 Dental Enamel Hypoplasia (DEH)

Enamel hypoplasia is a defect in the structure of tooth enamel (Forshaw, 2014). Enamel normally forms in two stages: the secretary stage where ameloblasts secrete the matrix proteins containing amelogenin, enamelin, ameloblastin and tuftelin, which then goes to a process of mineralisation (Soames and Southam, 2005). The second stage is maturation, characterised by a reduction of proteins and water from the enamel with the increase of mineral content in the matrix before tooth eruption (Soames and Southam, 2005). Disturbances of the normal activity of ameloblasts deposition or during mineralisation can lead to a reduction of enamel thickness or hypermineralisation of the enamel, respectively (Soames and Southam, 2005; Ogden, 2008). The appearance of enamel hypoplasia defects varies from small pits and furrows (linear enamel hypoplasia) to large and deep grooves, followed by plane-form hypoplasia (Ogden *et al.,* 2007; Hillson, 2014). Hypermineralised enamel appears white and opaque and may change in colour after tooth eruption (Soames and Southam, 2005). In bioarchaeological studies, enamel defects are usually recorded when they are macroscopically discernible and can indicate the age at the insult as well as the duration and severity of the stress (Buikstra and Ubelaker, 1994; Goodman and Song, 1999). Studies on enamel hypoplasia in archaeological populations were and are still the focus of most bioarchaeological research (Goodman and Rose, 1990; Larsen, 1997; Lukacs *et al.*, 2001; Griffin and Donlon, 2007; Ogden *et al.*, 2007; Masotti *et al.*, 2013; Cucina *et al.*, 2018). A large number of factors can cause enamel defects (Goodman and Rose, 1990; Larsen, 1997; King *et al.*, 2005). Dental enamel has been used in modern and prehistoric populations as an indicator of diet and general health status, although this association should be used in relation to other indicators of nutritional and disease status, due to the complexity of the defect and its aetiology (Goodman and Rose, 1990; Dobney and Goodman, 1991).

2.1.4.4 Skeletal Health

2.1.4.4.1 Introduction

Knowledge of the normal condition of the bone, at macroscopic and microscopic levels, is pivotal to interpret pathological lesions in human skeletal remains found in archaeological contexts (Ortner, 2003). The skeletal system is composed of bone, cartilage, tendons, and ligaments. These tissues have three main functions: support framework as attachment points for tendons and muscles for locomotion; protection of vital organs; and store calcium and phosphorous for minerals homeostasis (White *et al.*, 2012). Bone is made up of cells, collagenous organic matrix, and of inorganic hydroxyapatite. Adult bone undergoes remodelling that enables it to adapt to different functional situations and biochemical demands (Ortner, 2003). The balance between the processes of bone formation and bone resorption is key to maintain healthy bone mass. These processes are facilitated by the osteoblasts (bone-forming cells), which are responsible for the synthesis and deposition of bone cells; the osteocytes (osteoblasts surrounded by bony matrix), which are responsible of the final mineralisation of the bone and maintaining the bone structure, and the osteoclasts (removal cells), responsible for the resorption of bone tissue (Gosman, 2012; White *et al.*, 2012). In pathological conditions homeostasis is not maintained, leading to disease of erosive or proliferative nature as a result of the unbalanced bone turnover (Ortner, 2003; Gosman, 2012; Ragsdale and Lehmer, 2012).

2.1.4.4.2 Non- Specific Infectious Diseases

Infectious disease is a general disorder caused by bacteria, viruses, parasites or fungi (Ortner, 2008). Many of the skeletal changes of infectious origin are non-specific; they are categorised in osteomyelitis, osteitis, and periostitis depending on the type and location of skeletal tissue affected (Waldron, 2009). Signs of infectious diseases are not always visible on the human skeleton unless the disease reached the chronic stage where bones have the time to express the diagnostic features (Ortner, 2008). Bone formation and bone destruction are the skeletal manifestations most commonly observed. The nature of bone formation and destruction vary as a consequence of a diverse immune response to a pathogen (Ortner, 2003). The speed in which these lesions form varies, as does its expression (Table 2.1) (Ortner, 2008).

Table 2.1 Summary of types of bone formation and bone destruction according to the speed in which the lesions forms (from Ortner, 2008).

<table>
<tr><td colspan="3">Bone Formation</td></tr>
<tr><td>Rapid</td><td>Woven bone - Initial stage of abnormal bone forming lesions caused by infections. In later stages, woven bone can remodel in compact bone.</td><td rowspan="2">Rapid and slow bone formation can occur at the same time as an infectious response. Slow bone formation expressed as a central focus with woven bone and compact bone at the margin of the lesion.</td></tr>
<tr><td>Slow</td><td>Compact bone- result of chronic infections such as osteomyelitis</td></tr>
<tr><td colspan="3">Bone Destruction</td></tr>
<tr><td>Rapid</td><td colspan="2">Margin poorly defined. Difficulty in determining boundaries between normal bone and bone destroyed. No compact bone.</td></tr>
<tr><td>Slow</td><td colspan="2">Sclerosis at the margin of the lesion.</td></tr>
</table>

2.1.4.4.2.1 Periosteal Reaction

Inflammation of the periosteum (soft-tissue membrane that covers the outer surface of the bone) can be caused by many pathological conditions, infections or trauma (Ortner, 2003, 2008; Fornaciari and Giuffra, 2009). The periosteal reaction to neurovascular stimulus is manifested through pitting and abnormal bone formation on bone surface (Ortner, 2008; Weston, 2012). The skeletal tissue, which forms from the stimulation of the osteoblasts as a consequence of infection or trauma, can be a loosely organised woven bone or an organised dense compact bone. The former is the response to an acute condition, while the latter responds to a chronic condition. Periosteal lesions can occur as a primary pathological entity or as a secondary process of a disease such as tuberculosis, leprosy or syphilis (Weston, 2008; Fornaciari and Giuffra, 2009). In addition, lesions can affect a single skeletal element if localised, such as in the case of trauma, or multiple elements if systemic, like leprosy and tuberculosis (Larsen, 1997; Ortner, 2008).

Lesions of the periosteum are the most common feature found on skeletal remains of individuals from the past (Larsen, 1997; Paine *et al.*, 2009; Minozzi *et al.,* 2012). Due to the difficulty in determining the specific cause of periosteal reaction, bioarchaeologists commonly classify periosteal reactions and new bone formation as nonspecific infectious disease (Weston, 2008). Larsen (1997) stated that even if the nonspecific infections do not provide a diagnostic picture of health, the recording and documentation of periosteal reactions prevalence can give valuable information on specific lifeways of past populations. However, caution should be taken in diagnosing periosteal lesions as a consequence of infectious disease on incomplete skeletons (Weston, 2008).

2.1.4.4.2.2 Endocranial Lesions

The term endocranial lesion indicates reactive new bone that forms on the internal surface of the cranium (endocranium). The lesions appear like diffuse or isolated canaliculi expanding near the meningeal vessels and it is considered a lesion that mainly affects immature individuals (Lewis, 2004). The aetiology of the endocranial lesions is still debated. Several explanations were suggested including epidural haematoma as a result of trauma, inflammation of the meninges (Schultz, 1989), and respiratory disease such as tuberculosis (Hershkovitz *et al.,* 2002). Endocranial lesions were also defined with the term serpens endocrania symmetrica (SES) (Hershkovitz *et al.,* 2002). Lewis (2004) argued that these lesions in immature individuals are the result of inflammation or haemorrhage of the meninges. The inflammation can be caused by a bacterial infection, vitamin deficiency, it can occur as a secondary response to osteitis media, syphilis, pneumonia, and gastroenteritis, or during the primary infection caused by *Mycobacterium tuberculosis* (Schultz, 2001; Hershkovitz *et al.,* 2002; Lewis, 2004). The appearance of new bone on the endocranium is the result of a chronic condition and not an acute form, as the latter would have caused the immediate death of the individual preventing the lesion to express (Lewis, 2004).

Lewis (2004) suggested to observe other pathological features present on the skeleton to be able to understand the aetiology of the cranial lesions. Studies of endocranial lesions in immature and adult individuals of past populations are increasing (Hershkovitz *et al.,* 2002; Lewis, 2004, 2007; Masson *et al.,* 2015; Janovic *et al.,* 2015; Köhler *et al.,* 2017). However, there are very few publications on the presence of this pathology considering Italian ancient populations (Minozzi *et al.,* 2012).

2.1.4.4.2.3 Sinusitis

Sinusitis is an inflammation of the mucous membrane of paranasal sinuses and can be diagnosed as acute, subacute, and chronic (Lewis *et al.,* 1995; Roberts, 2007). The acute and subacute sinusitis last less than 8 weeks and do not cause changes to the bone tissue. If these conditions develop into a chronic stage (more than 8 weeks), extensive new bone may form on the floor of the sinus (Slavin *et al.,* 2005; Roberts, 2007; Waldron, 2009). Bacterial organisms involved in chronic sinusitis are *Streptococcus pneumoniae, Haemophilus influenzae,* and *Moraxella catarrhalis,* as well as, *Staphylococcus aureus, Pseudomonas aeruginosa, certain anaerobes,* and fungi (Slavin *et al.,* 2005). The inflammation of sinuses is mainly caused by aetiological conditions that trigger the sinus infection such as poor ventilation, air pollution, allergies, respiratory tract infections, and dental diseases (Lewis *et al.,* 1995; Aufderheide and Rodríguez-Martín, 1998; Mehra and Jeong, 2009). In archaeological human remains, chronic sinusitis can be detected through x-rays or CT scan in case of intact skull, or macroscopic direct visual observation and endoscopy in case of broken or partially broken skull. Frontal and maxillary sinuses are the most frequent areas where presence of chronic sinusitis can be diagnosed in archaeological human remains (Boocock *et al.,* 1995; Lewis *et al.,* 1995; Capasso, 2007; Sundman and Kjellström, 2013; DiGangi and Sirianni, 2017).

2.1.4.4.3 Cribra Orbitalia

Cribra orbitalia is identified as porosity and pitting of the orbital roof (Ortner, 2003). The orbital lesions are considered as the initial stage of the porotic hyperostosis seen in the cranial vault (cribra cranii) (Angel, 1966; Wapler *et al.,* 2004). Porotic hyperostosis is expressed in symmetrically distributed cranial lesions and is characterised by the thinning of the external lamina and the thickening of the diploë of the skull in response to hyperplasia of the hematopoietic marrow (Aufderheide and Rodríguez-Martín, 1998; Ortner, 2003). Porotic hyperostosis is a condition that affects immature individuals (Aufderheide and Rodríguez-Martín, 1998). Until recently the aetiology and cause of cribra orbitalia was only associated to iron-deficiency anaemia, either acquired or genetic (thalassemia or sicklemia). New research has shown that also megaloblastic anaemia also causes cribra orbitalia (Walker *et al.,* 2009). Infants develop megaloblastic anaemia both when they ingest maternal milk depleted of vitamin B_{12} and are exposed to unsanitary living conditions. The low maternal vitamin B_{12} intake plus the loss of additional nutrients due to gastrointestinal infections, contracted due to poor living condition, result in vitamins deficiency including co-deficiency of vitamins B_{12} and C, leading to the development of cribra orbitalia (Walker *et al.,* 2009).

Ortner (2003) highlighted the fact that porotic hyperostosis of the cranial vault and cribra orbitalia may represent the symptom of several other diseases such as metabolic disease, infectious disease, and cancer. Therefore, he suggested that microscopic analysis could help to establish the correct diagnosis. Wapler *et al.* (2004), using histological analysis, noticed that the aetiology of cribra orbitalia was linked to anaemia only in less than half of the investigated cases; the rest were not displaying anaemia but still expressed cribra orbitalia. This has demonstrated that the diagnosis for the cribra orbitalia is not straightforward and multiple probable causes can trigger the formation of pitting and porosity in the orbital roof. Cribra orbitalia, despite all the limitations related to its aetiology, is still considered a potential indicator of stress (Larsen, 1997; Liebe-Harkort, 2012; Manzon and Gualdi-Russo, 2016; Zarina *et al.*, 2016).

Cribra orbitalia is one of the most frequent lesions found on human skeletal remains (Larsen, 1997; Roberts and Cox, 2003). In the research conducted by Fornaciari *et al.*

(1989) on the skeletons from the Pontecagnano cemetery dating 7th–3th centuries BC (Central Italy), it was noticed that the presence of cribra orbitalia was not linked to nutrition deficiency. Paleodiet analysis showed that the individuals buried in this cemetery had diets rich in proteins; this led to the consideration that cribra orbitalia was of congenital origin, probably thalassemia. In addition, the percentage of individuals showing cribra orbitalia was lower in the 5th century BC compared to the previous period, suggesting a reduction of areas where the malaria pathogen was present in Central Italy (Fornaciari *et al.*, 1989). In contrast, Facchini *et al.* (2004) linked the high frequency of cribrotic lesions in sub-adults and adult individuals from the Roman cemeteries of Rimini and Ravenna (1th-4th centuries AD) to acquired chronic anaemia. Specifically, Facchini *et al.* (2004) linked the cribrotic lesions to nutritional stress, parasitic infections, and environmental conditions. Studies on the relationships between presence of cribra orbitalia and social status in an Iron Age sample from Pontecagnano (Robb *et al.*, 2001), Samnites population from Abruzzo (Sparacello *et al.*, 2017), and the Anglo-Saxon cemetery from Raunds Furnells (Craig-Atkins and Buckberry, 2010), showed that there were not significant differences between prevalence of cribra orbitalia and social status.

2.1.4.4.4 Joint Diseases

2.1.4.4.4.1 Osteoarthritis

Osteoarthritis (OA) is considered one of the most common pathology found in archaeological human skeletal remains (Ortner, 2003; Waldron, 2009). OA is a chronic, inflammatory disease which primarily affects synovial joints, including and apophyseal joints of the vertebrae (Aufderheide and Rodríguez-Martín, 1998; Waldron, 2009). Synovial joints are the most common type of joints in the body and are the ones with the highest capacity of mobility (e.g., shoulder, elbow, hand, hip, knee, and ankle). Due to their structural characteristics and biomechanical properties synovial joints are more prone to developing arthritic pathologies (Waldron, 2009). The progression of OA is characterised by three major stages, described in Figure 2.2. In diagnosing OA in archaeological human remains, Rogers *et al.* (1987) stated that the osteoarthritic lesions can be classified as present only when both marginal osteophytes and eburnation are visible on the affected joint.

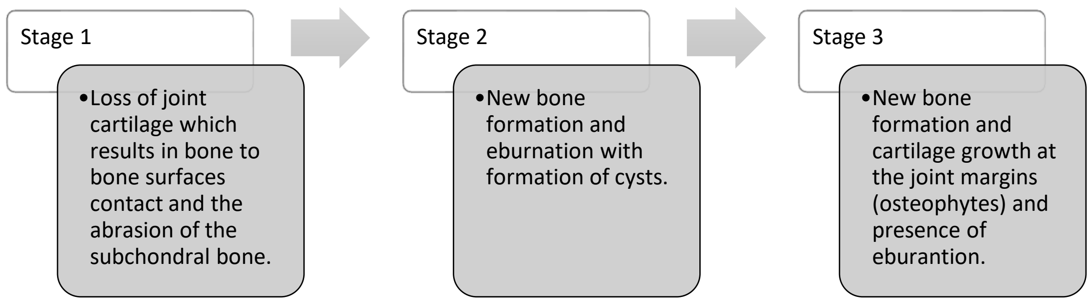

Figure 2.2 The three major stages of the osteoarthritis progression. After Ortner, 2003.

Osteoarthritis can be divided into primary and secondary. Primary OA is a condition that is usually manifested later in life as a consequence of several factors, such as biomechanical stresses or trauma, whereas secondary osteoarthritis occurs early in life in joints that are abnormal due to a pathological condition (Ortner, 2003). Waldron (2009) defines primary OA when the cause of the disease is unknown from the skeletal remains, while it is secondary when the cause is evident, such as OA developed following a fracture. Until recently, scholars referred to OA as a degenerative disease considering inflammation as not primary aspect of OA (Jurmain and Kilgore, 1995; Ortner, 2003). However, new clinical and paleopathological researches stresses inflammation as a factor which is present in the pathogenesis of OA (Dieppe, 1987; Punzi *et al.*, 2005; Waldron, 2009).

The aetiology of osteoarthritis is multifactorial and still not fully understood, although different factors, such as sex, age, body mass, genetic, trauma, and biomechanical stress, as well as other pathological conditions are considered to be involved in the development of OA (Solano, 2002; Ortner, 2003; Weiss, 2007; Waldron, 2009). Many studies focused on the relationship between biomechanical stresses and physical activities as a primary factor contributing to osteoarthritis (Sofaer Derevenski, 2000; Lieverse *et al.*, 2007; Rojas-Sepúlveda *et al.*, 2008). However, the link between mechanical loading and OA is not always straightforward (Larsen, 1997; Weiss and Jurmain, 2007).

2.1.4.4.4.2 Degenerative Disc Disease

Degenerative disk disease refers to the degeneration of the cartilaginous structure of the synchondroses joints of the spine (Aufderheide and Rodríguez-Martín, 1998; Ortner, 2003; Waldron, 2009). Most changes on the intervertebral discs are age related and commonly start to appear around the age of 40, with an increasing degeneration in people over the age of 70 (Waldron, 2009). Vertebral bodies articulate via an intervertebral disk that comprises an annulus fibrosus (outer ring of fibrous cartilage), which surrounds the nucleus pulposus (gelatinous core) (Urban and Roberts, 2003). Degeneration of the intervertebral disc results in the annulus collapsing and the immediate loss of the disc's height, losing the ability to dissipate stress resulting from load bearing. Under these conditions, the apophyseal joints occasionally develop osteoarthritis, due to abnormally great loads (Urban and Roberts, 2003). The contact between vertebral bodies stimulate the formation of marginal osteophytes and pitting in the superior, inferior or both surfaces of adjoining vertebrae; in addition, porosity is often seen on the vertebral bodies end-plates (Aufderheide and Rodríguez-Martín, 1998; Waldron, 2009).

One of the most common intervertebral disc disorder is represented by the herniation of the nucleus pulpous through the annulus fibrosus into the end-plate of the adjacent vertebra, referred to as Schmorl's nodes (Schmorl and Junghanns, 1971; Urban and Roberts, 2003). The disk hernia can be grouped in three different forms: (1) vertical disc hernia, where the disks protrudes through the vertebral end-plate into the subchondral space of the vertebral body (Schmol's node); (2) lateral and anterior disc hernia, causing osteophytosis; (3) posterior disk hernia, causing osteolysis of the posterior margin (Aufderheide and Rodríguez-Martín, 1998; Ortner, 2003). Schmorl's nodes are the most recorded and are easily identified in archaeological human remains (Ortner, 2003). The presence of Schmorl's nodes is linked to mechanical stress and workload, usually used to interpret activity and occupations of past human populations (Robb *et al.*, 2001; Wentz and Grummond, 2009; Jiménez-Brobeil *et al.*, 2010; Plomp *et al.*, 2012). Even though Schmorl's nodes have always been considered as result of workload, their aetiology is not fully understood. In fact, other factors such as trauma and/or congenital disorder can also be involved in the protrusion of the vertebral disc (herniation) (Weiss, 2005; Jurmain *et al.*, 2012; Plomp *et al.*, 2015).

2.1.4.5 Trauma

Lovell (1997, p. 139) defines trauma as "*an injury to living tissue that is caused by a force or a mechanism extrinsic to the body*". Controversies are expressed about the classification of trauma. Lovell (1997) highlights the importance to divide skeletal injuries according to their main features (fracture and dislocation), while other scholars tend to group traumatic injuries into categories such as accidental or intentional (scalping, mutilation, osteochondritis dissecans, spondylosis, tooth loss, Harry lines) which implies causation or intent (Lovell, 1997; Aufderheide and Rodríguez-Martín, 1998; Ortner, 2003; Bennike, 2008).

Fractures are the primary traumatic injuries found in archaeological settings (Larsen, 1997; Roberts and Manchester, 2005; Waldron, 2009) . A fracture consists of a partial or complete interruption of bone continuity caused by mechanical stresses applied to the bone, which may or may not cause injuries to the overlying soft tissues (Lovell, 1997; Aufderheide and Rodríguez-Martín, 1998; Ortner, 2003). Different mechanisms of injury result in specific types of fracture (direct trauma, indirect trauma, stress and secondary to pathology (Lovell, 1997; Aufderheide and Rodríguez-Martín, 1998). A fractured bone goes through an immediate process of healing that starts soon after the bone is broken. According to Paton (1984), there are five stages of healing: (1) hematoma formation, (2) cellular proliferation, (3) callus formation, (4) consolidation, and (5) remodelling. It is only after the third week that a fibrous union (callus) appears around the fractured bone and stabilises it (Lovell, 1997; Aufderheide and Rodríguez-Martín, 1998). Consolidation and remodelling are the slowest stages and they differ according to skeletal elements and individuals age (Aufderheide and Rodríguez-Martín, 1998). Fractures can result in complications, such as pseudarthrosis, osteoarthritis, osteomyelitis, bone shortening, infection, avascular necrosis (Aufderheide and Rodríguez-Martín, 1998; Ortner, 2003; Waldron, 2009). The study of fracture complications provides important information on mobility, presence or absence of medical treatments, morbidity and mortality (Lovell, 1997).

The importance in studying trauma in paleopathology relies on two significant aspects, the anatomical importance of the injury itself, and the social, cultural and environmental causes behind the trauma (Lovell, 1997; Bennike, 2008). This provides valuable information on behaviour and lifestyle of ancient populations such as inter- and intra-group conflicts and work occupations which might have caused lesions of accidental origin (Lovell, 1997; Aufderheide and Rodríguez-Martín, 1998; Ortner, 2003; Knüsel and Smith, 2014). The recent study performed on the skeletal human remains from the Alfedena cemetery in Italy (Samnite population 6th–5th centuries BC) showed that violent situations were experienced by the Samnites (Paine *et al.,* 2007). A considerable number of adults (12.9%) exhibited cranial trauma, with males showing a higher percentage than females. Paine *et al.* (2007) concluded that the injuries on male individuals occurred as result of small-scale conflicts over resources. They also argued that traumatic injuries and behaviour of a population should be interpreted and discussed according to the socio-cultural aspects of the community, confined in period and location (Paine *et al.,* 2007).

2.1.5 Analytical Methods to Reconstruct Diet and Mobility

2.1.5.1 Dental Microwear Texture Analysis

Dental microwear has been proven to be efficient in reconstructing the dietary pattern of non-human primates (e.g. Teaford and Walker, 1984; Ungar, 1994; Nystrom *et al.,* 2004, hominins (Ungar and Grine, 1991; Scott *et al.,* 2005; Grine *et al.,* 2006) and prehistoric and recent humans (e.g. Mahoney, 2006a, 2006b, 2007; Nystrom, 2008; Krueger and Ungar, 2012; García-González *et al.,* 2015; Schmidt *et al.,* 2015; Karriger and Schmidt, 2016). Microwears consist of microscopic traces of enamel damage produced on the occlusal or buccal tooth surfaces, as a consequence of mastication, and the type of food or grit particles that impact on the enamel surface during chewing (Crompton and Hiiemae, 1970; Jarosova *et al.,* 2006; Schmidt *et al.,* 2015; Ungar, 2015). These microfeatures are classified into pits and scratches (Figure 2.3). Pits tend to form when hard abrasive particles (hard food items that require more masticatory demand) are driven or compressed into the enamel surface, whereas scratches occur when particles (exogenous grit, dust, and/or phytoliths adhering to or within the food) are driven and sheared between the two tooth occlusal surfaces during chewing (Schmidt, 2001; Mahoney, 2006c). Studies on dental microwear demonstrated that size, orientation, frequency and morphology of pits and scratches, the microwear patterns, vary according to changes in dietary hardness and abrasiveness (Mahoney, 2006c; Schmidt *et al.*, 2015). In addition, other variables have been observed to affect the pattern of microwear such as jaw mechanics (Gordon, 1984) and size of the particles (Mahoney, 2006b, 2006c).

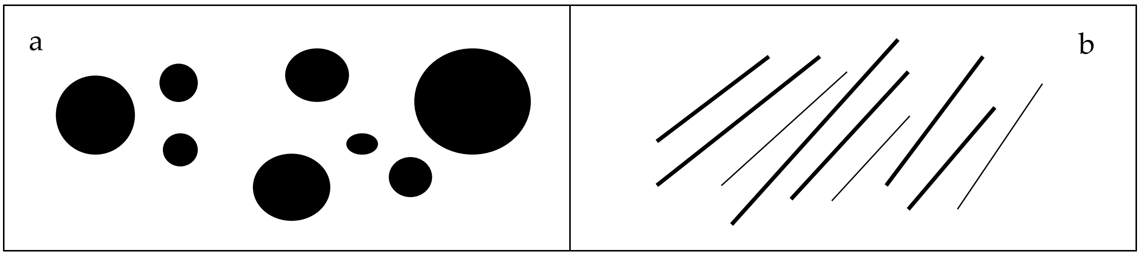

Figure 2.3 Schematic representation depicting microfeatures on tooth surfaces: pits (a) and scratches (b). Drawing by the author.

Until recently dental microwear was studied counting and measuring enamel features on two-dimensional images acquired from tooth surface using scanning electron microscopy (SEM) (Grine *et al.*, 2002; Schmidt, 2010). Various problems, however, resulted from SEM images; among those the subjectivity and the high interobserver error rate, when the identification and the measurements of the features were performed (Scott *et al.*, 2006). These limitations were overcome by the use of dental microwear texture analysis, a three-dimensional approach that uses a white-light confocal microscopy and scale-sensitive fractal analysis to collect and analyse 3D surface data (Ungar *et al.*, 2003, 2008; Scott *et al.*, 2005, 2006; Schmidt *et al.*, 2015). This technique reduces the sources of error, provides a repeatable and quantitative analyses of the tooth surface, and enables the assessment of large samples due to its rapidity (Ungar *et al.*, 2003). The dental microwear surface texture analysis (DMTA) collects data of surface complexity (Asfc) (rough or smooth tooth surface), features orientation (epLsar) (degree in which jaw moves in a consistent direction), and the textural fill volume (Tfv) (quantity of surface removed as an effect of microfeatures formation) (Schmidt *et al.*, 2015). Schmidt *et al.* (2015) found that fibrous diets produce surfaces with features having a similar orientation (observed in pastoralists) (Figure 2.4 a), while hard diets produce more complex occlusal surface (seen in agriculturists) (Figure 2.4 b). This research demonstrated that dietary habits between agriculturists and pastoralists can be distinguished through microwear analysis, and that other factors, such as ecogeography and food preparation, might impact the interpretation of the diet (Schmidt *et al.,* 2015).

a

b

Figure 2.4 Example of 2D and 3D microwear images of pastoralist (a) showing a less complex surface with minor relief and low anisotropy of scratch features, and agriculturist (b) showing a more complex surface with greater relief and higher anisotropy of scratch features (From Schmidt et al., 2015).

Dental microwear texture analysis on deciduous teeth to address childhood diet is still under-researched. Few articles were published using SEM (Bullington, 1991; Molleson and Jones, 1991; Fox and Pérez-Pérez, 1993), whereas only one study has been conducted using DMTA (Mahoney *et al.,* 2016). Mahoney *et al.* (2016) examined human deciduous teeth from Medieval England and found that that younger children (1-2 years old) were fed with a mixed food diet, suggesting that the weaning process had started. A variation of the physical properties of diet was seen among the age groups; with children from 4 to 6 years old consuming tougher food, while the older children (6.1 - 8 years old) consumed harder food. In addition, this study showed an unclear relationship between socio-economic status and diet, observed also in adults. As the authors note, DMTA was capable of distinguishing subtle evidence of past childhood dietary habits (Mahoney *et al.,* 2016).

2.1.5.2 Isotope Analysis

Isotopes are different atoms of the same element having the same number of protons and electrons but different number of neutrons, therefore a different mass number and different physical properties. In nature, there are stable and radioactive isotopes. Stable light isotopes such as carbon (^{12}C, ^{13}C), nitrogen (^{14}N, ^{15}N), oxygen (^{16}O, ^{18}O), and sulphur (^{16}S) do not decay over Earth's lifetime. Whereas radioactive isotopes like rubidium (^{87}Rb), samarium (^{147}Sm), uranium (^{238}U and ^{235}U) decay into radiogenic isotopes such as strontium (^{87}Sr), neodymium (^{143}Nd), lead (^{206}Pb and ^{207}Pb) at a discernible rate through Earth's life (Roy-Barman and Jeandel, 2016). Light isotopes go through a process called isotopic fractionation, where isotopes of the same element "separate" during chemical, physical or biological processes (Schwarcz and Schoeninger, 1991; Nord and Billström, 2018). Isotope fractionation is a mass-dependent mechanism, thus occurs because of differences in mass between isotopes. Mass differences influence the isotope behaviour during physical properties and chemical processes, leading to isotope fractionation or isotope partitioning. This results in changes in the relative abundance of the isotope in the source and the product compound of a transformation (Schwarcz and Schoeninger, 1991; Sulzman, 2007; Lee-Thorp, 2008). Strontium and lead isotopes behave differently from the light isotopes and do not fractionate (Montgomery and Evans, 2006; Flockhart *et al.*, 2015). The isotopic composition of a material is calculated following the formula displayed below (Coplen, 1994) [1.1]

$$\delta(‰) = \left(\frac{R\ sample}{R\ standard} - 1\right)\ x\ 1000 \qquad [1.1]$$

Where R is the ratio between the heavy and light isotopic abundances in the sample and in the standard. The isotope composition is expressed as a deviation in part per thousand from an international reference standard material: Vienna Pee Dee Belemite (VDPB) for carbon stable isotope analysis; atmospheric AIR (N_2) is used for nitrogen stable isotope analysis (Ehleringer and Rundel, 1989; Schwarcz and Schoeninger, 1991; Michener and Lajtha, 2007). Positive $\delta(‰)$ means that the heavy isotope is enriched in the sample compared to the standard. In contrast, negative $\delta(‰)$ means that the heavy isotope is depleted in the sample compared to the standard (Michener and Lajtha, 2007).

A mass spectrometer is used to determine the stable isotope ratios in a material. The isotope ratio mass spectrometry (IRMS) is used to quantify mass differences of carbon and nitrogen isotopes in collagen and bioapatite. A thermal ionisation mass spectrometry (TIMS) or a plasma ionisation mass spectrometry (PIMS) and inductively coupled plasma mass spectrometry (ICP-MS) are used for strontium isotopes analysis (Brown and Brown, 2011). However, TIMS is preferred and used in this project due to its precision and accuracy in measuring strontium isotope ratios in archaeological samples with low elemental composition (Pollard *et al.,* 2007). Application of isotope analyses in archaeological and bioarchaeological research has resulted in a wide range of use. In particular, isotope analyses have enabled researchers to reconstruct the palaeodiets (e.g. Prowse *et al.,* 2005; Chenery *et al.,* 2010) and migration patterns of past populations (e.g. Chenery *et al.,* 2010; Killgrove, 2010; Killgrove and Montgomery, 2016; Cavazzuti *et al.*, 2018, 2019).

2.1.5.3 Carbon and Nitrogen Isotope Analysis

Carbon and nitrogen are stable isotopes used in bioarchaeology to reconstruct the diet of past populations. The method is based on the principle that carbon ($^{13}C/^{12}C$) and nitrogen ($^{15}N/^{14}N$) isotope ratios in bone collagen and dentine reflect the isotope ratios in the diet, taking into account the isotope fractionation. Diet rich in marine or terrestrial resources, and the typology of foodstuff consumed where maize or other cereals can be distinguished (Brown and Brown, 2011).

Carbon has two stable isotopes in nature: carbon-12 (or ^{12}C) and carbon-13 (or ^{13}C). ^{12}C is the lightest isotope and exists in the environment in large quantity (98.93%), whereas ^{13}C is the heaviest and exists only in traces (1.07%) (Schwarcz and Schoeninger, 1991; Ehleringer and Rundel, 1989; Pollard *et al.,* 2007). The principle behind the distinction between foodstuff consumption among people in the past lies on the type of photosynthetic pathway that plants operate, consequently the ^{12}C enrichment during carbon isotope fractionation. In nature plants follow two different photosynthetic pathways, the C_3 (e.g., wheat, barley, most fruits and vegetables) and the C_4 (e.g., millet, sorghum, sugar cane and maize) (Brown and Brown, 2011). C_3 plants have two stages of carbon dioxide (CO_2) enrichment. Firstly, as for all plants, the atmospheric carbon dioxide enters in the plant enriching the plant of ^{12}C, a subsequent ^{12}C enrichment starts during plant photosynthesis, when CO_2 molecules containing ^{12}C are converted into sugar. Hence, C_3 plants have lower $\delta^{13}C$ (~ -26.5‰) than the atmospheric ones (~ -7‰) because of these two ^{12}C enrichments. These plants are found in temperate regions. On the contrary, C_4 plants follow one stage of photosynthetic pathway and therefore, one isotope fractionation. C_4 plants absorb CO_2, and all the carbon dioxide absorbed is converted into sugar. $\delta^{13}C$ values in C_4 plants (~ -12.5‰) is lower that the atmospheric ones, but not as the $\delta^{13}C$ values of C_3 plants (e.g., Craig, 1953; Smith and Epstein, 1971; O'Leary, 1988; Ehleringer and Rundel, 1989; Schwarcz and Schoeninger, 1991; LeHuray *et al.,* 2009). $\delta^{13}C$ values of a human or animal is the reflection of the $\delta^{13}C$ values of the foodstuff consumed; hence, a diet rich in C_3 plants is distinguishable from a diet rich in C_4 plants (Vogel and Van Der Merwe, 1977; Tauber, 1981; Chisholm *et al.*, 1982; Schwarcz and Schoeninger, 1991). In marine plants carbon undergoes a two stages photosynthesis but, differently from C_3 plants, marine plants acquire carbon from dissolved bicarbonate, which is enriched of ^{13}C rather than ^{12}C showing $\delta^{13}C$ values of around -20‰ (Craig, 1953). Differently, freshwater plants have $\delta^{13}C$ values similar to terrestrial ones.

Nitrogen is an additional stable isotope that provides complementary information on dietary study. The primary principle of nitrogen is that it varies according to the trophic level. The standard used to evaluate the $\delta^{15}N$ vales of plants, humans, and animals, is the atmospheric N_2 standard (0‰) (DeNiro and Epstein, 1981; Katzenberg, 2007; Lee-Thorp, 2008). Based on this principle, soil and non-leguminous plants have $\delta^{15}N$ vales of circa +1-4‰ higher than the atmospheric values. $\delta^{15}N$ vales in a marine environment are more positive of the $\delta^{15}N$ values of the terrestrial ones because more denitrification occurs in marine water, with an increase that ranges from the +5-6‰. Hence, if $\delta^{13}C$ values of human skeletons are plotted against $\delta^{15}N$ values, marine diet signals will cluster around $\delta^{13}C$ = ~ -16‰, and $\delta^{15}N$ = ~ +12-16‰. Freshwater foods have higher $\delta^{15}N$, although their $\delta^{13}C$ do not increases in values like for marine foods (Dufour *et al.,* 1999) (Figure 2.5).

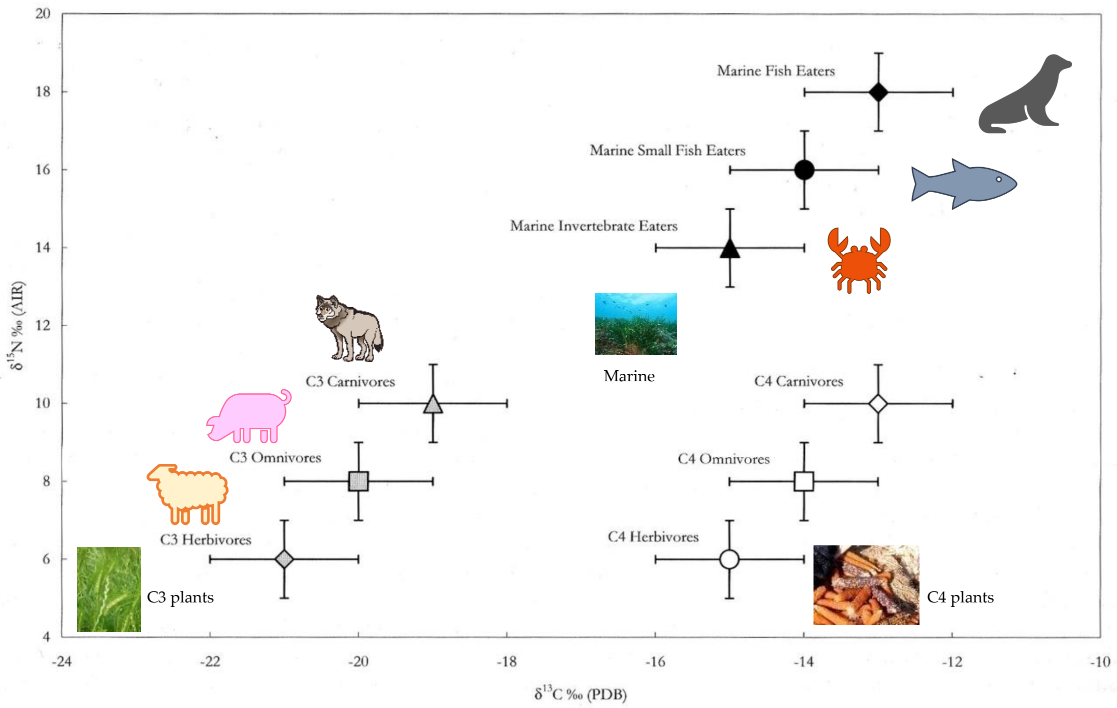

Figure 2.5 Example of stable isotope bi-variate plot showing theoretical data points for specific diets (Modified from Le Huray et al., 2006. In Gowland and Knusel (2006), Social archaeology of funerary remains). Creative Commons licenses: Grass image: "Grasses" by WiggyToo is licensed under CC BY-NC-ND 2.0; Corn image: "PA120833 Ardenwood 20131012" by caligula1995 is licensed under CC BY 2.0; Seagrass image: "Posidonia" by Marta T.L. is licensed under CC BY-NC-ND 2.0.

Nitrogen isotope analysis allows also to differentiate herbivorous from carnivorous diet. The trophic shift of $\delta^{15}N$ values from plants to herbivores and herbivores to carnivores is approximately of +3-5‰ while $\delta^{13}C$ values increases of +1-2‰ (Minagawa and Wada, 1984; Schoeninger and DeNiro, 1984; O'Connell *et al.*, 2012). The shift in isotopic values for humans, which consumes both animals and plants in different proportions, enables the discrimination of individuals who had a meat-based diet from those whose diet is depended on plants or freshwater and marine fish (Katzenberg, 2008; Brown and Brown, 2011). ^{15}N values, in association with ^{13}C, has been used to determine when weaning occurred, as children show an enrichment of ^{15}N 3‰ higher than their mothers during breastfeeding (e.g., Schurr, 1997; Herring *et al.*, 1998; Richards *et al.*, 2002; Fuller *et al.*, 2006; Eerkens *et al.*, 2011; Pfeiffer *et al.*, 2017). There are various factors, however, that influence the shift and the obtained $\delta^{15}N$ values, and they should be taken into account during the dietary reconstruction. These are the loss of ^{15}N-depleted products like urea, or the diet to tissue variability amongst species with different physiology (Ambrose and Norr, 1993; DeNiro and Epstein, 1978; Hedges and Reynard, 2007; Lee-Thorp, 2008). Given the above issue, researchers are currently unsure on what the exact ^{15}N enrichment values in humans are (Hedges and Reynard, 2007; Lee-Thorp, 2008). Studies using stable isotope have been widely applied to investigate diet of ancient populations. However, very few studies have been conducted on pre-Roman and Roman Italy, with most of the contribution coming from the research at the Roman age cemetery of Isola Sacra, Rome (e.g., Prowse *et al.*, 2004, 2007, 2008; Craig *et al.*, 2009).

2.1.5.4 Strontium Isotope Analysis

The use of strontium isotopes in studying human mobility relies on the fact that the isotope composition of an individual reflects the geographic area a person lived in while bone and teeth were forming (Ericson, 1985). Strontium is present in the environment as a trace element and it is found in different rock types, in groundwater, in oceans, in soil, in plants, in animal and human tissues. In nature there are four stable strontium isotopes with different abundances (^{84}Sr = ~0.56%, ^{86}Sr = ~9.87%, ^{87}Sr = ~7.04%, and ^{88}Sr = ~82.53%). Of these, ^{87}Sr is the only radiogenic isotope and is formed by the natural radioactive decay of rubidium-87 (^{87}Rb). Consequently, the amount of ^{87}Sr increases with time as the ^{87}Rb half-life is 4.9 x 10^{10} years (Faure and Mensing, 2005; Bentley, 2006; Brown and Brown, 2011). The abundance of ^{87}Sr, calculated as a ratio between ^{87}Sr, the radiogenic isotope that vary with time, and ^{86}Sr, the non-radiogenic ones ($^{87}Sr/^{86}Sr$), depends on the amount of initial rubidium and strontium (Rb/Sr) present in the rock when it formed, and the age of the rock. Old rocks such as granites and shales have high Rb/Sr ratios and, therefore, the highest $^{87}Sr/^{86}Sr$ values (~0.740), whereas young volcanic rocks have the lowest $^{87}Sr/^{86}Sr$ values (~0.703). $^{87}Sr/^{86}Sr$ ratios vary between bedrock of different geology (Montgomery, 2002; Faure and Mensing, 2005; Bentley, 2006; Brown and Brown, 2011; Slovak and Paytan, 2011).

The weathering of rocks releases strontium in the biosphere. Strontium, being a heavy element, does not fractionate, thus its initial ratio does not change when it enters in groundwater, soil, plants, animals and humans (Montgomery and Evans, 2006; Flockhart *et al.*, 2015). Humans acquires strontium through diet, and it is incorporated in skeletal tissues due to the chemical properties that strontium and calcium share. Strontium is therefore incorporated in calcium-containing structures like inorganic parts of bones and teeth as a calcium substitute (Budd *et al.*, 2004). The $^{87}Sr/^{86}Sr$ ratio obtained from the analysis of bone or teeth of an individual allows a straight connection with the geology and, for this reason, it enables a reconstruction of the mobility, or residence, at the time of teeth formation and after bone remodelling (Budd *et al.*, 2004). Once formed, teeth, in contrast to bone, do not change their chemical composition (Hillson, 1986), $^{87}Sr/^{86}Sr$ ratios from teeth therefore reflect the $^{87}Sr/^{86}Sr$ ratios of the geological composition during their formation, providing an indication of the area in which the individual grew up (Budd *et al.,* 2000; Bentley, 2006).

There are several limitations to be considered when interpreting strontium isotope ratios. Slovak and Paytan's, (2011) stated three main limiting factors, following Ericson's (1985) considerations. The first one is the difficulty in distinguishing the area of origin due to the lack of geological variability of the territory, and for this reason, the biosphere $^{87}Sr/^{86}Sr$ signatures of the area are essential. The second one refers to the imprecision of the strontium isotope analyses in tracking movements between coastal areas. The third limiting factor is related to the variation of the strontium ratios when non-local food was consumed; therefore, it is prudent to have information on the possible diet of the studied individuals. In addition, diagenesis is one of the main limitations when analysing strontium isotopes. Bones and teeth can be subjected to molecular alterations, including loss of $^{87}Sr/^{86}Sr$ signatures in post-depositional environment, as a consequence of physical and chemical changes (Nelson *et al.*, 1986; Lee-Thorp, 2002, 2008; Hoppe *et al.*, 2003). Due to its compact, dense and hard structure, tooth enamel is resistant to diagenesis, and for this reason, it is preferred in isotopic studies (Budd *et al.,* 2000; Hoppe *et al.*, 2003; Bentley, 2006; Slovak and Paytan, 2011).

Research on mobility and migration using strontium isotope analysis is currently widely applied in bioarchaeological studies, and an extensive range of articles were published on Roman and Medieval England (e.g., Budd *et al.,* 2004; Evans *et al.,* 2006; Chenery *et al.,* 2010; Brettell *et al.,* 2012; Beaumont and Montgomery, 2016; Shaw *et al.,* 2016). In Italy, however, the use of strontium isotope to investigate migration is still at the formative stage. Most of the studies come from archaeological sites excavated in Rome or in the surrounding area. For example, the research conducted by Killgrove and Montgomery (2016) on two imperial Rome cemeteries (Casal Bertone and Castellaccio

Europarco) shows that several individuals were probable migrants. Prowse *et al.* (2007) in the study on Isola Sacra cemetery (*Portus Romae* near Rome) demonstrated that the process of migration in Rome was more complex than previously thought, involving families and single adult males. Cavazzuti *et al.* (2019b, 2019a) investigated mobility patterns during the Bronze Age in the cemeteries of the Po valley finding that people moved within a radius of 50 km and, in particular for the cemetery of Frattesina, the elites were more likely to migrate. The only contributions on strontium isotope analysis in the Abruzzo Region comes from the research of Pellegrini *et al.* (2008) on faunal migration in the late-glacial period, and from the study of Nicholls *et al*. (unpublished) on the practice of transhumance during the Iron Age period between the Upper and Lower Sangro valley.

2.2 The Social Body: Identity, Gender, and Social Status in Past Populations

The purpose of bioarchaeology, and of this thesis, is to reconstruct the biocultural identity of past populations by contextualising skeletal indicators in a cultural and social sphere. Contextual elements, such as the presence or absence of grave goods in burials and the typology, dimension and location of burials, shed light on cultural identity, gender and social differences of individuals in past populations. Scheper-Hughes and Locke, (1987, p. 7) describe the social body as: "[…] a natural symbol with which to think about nature, society, and culture", highlighting the influence that the social context has on the body and an individual's behaviour. The mortuary context, therefore, reveals how the individual was viewed by society and provides information on ideology and social structures on a larger scale (Zvelebil and Weber, 2013).

2.2.1 Identity

Defining identity has been and continues to be a challenge for archaeologists, anthropologists and social scientists. The word identity reflects, as defined in the *Collins English Dictionary,* "the individual characteristics by which a person or thing is recognised" ("Identity," n.d.). This definition stresses the double significance that the word identity has. Each individual communicates how he/she perceive himself/herself through objects or behaviours in a collective dimension, which is linked with public, social and ethnic recognition (Cuozzo and Guidi, 2013; Hodos, 2014). The notion of identity thus depends on the oppositions to something else, since social groups are selected by individuals on the bases of sharing similarities (Hodos, 2014). Similarly, Díaz-Andreu and Lucy (2005) provided a definition of identity where the focus is on the individuals' sense of belonging to certain socially selected groups. In the authors' view, agency and choice are two fundamentals for the individual's identity development and preservation. Contemporary scholars considered individuals as the container of multiple culturally constructed identities, such as age, gender, religion, ethnicity, and so forth, which of course need to be considered simultaneously and not as categorical identities (Díaz-Andreu and Lucy, 2005; Cuozzo and Guidi, 2013; Gowland, 2017). These categories are not permanently attached to an individual, but they can change over time, according to specific circumstances, as a constant process of an individual's recognition within social relations (Díaz-Andreu and Lucy, 2005; Remotti, 2010). Moving forward from the consideration of the identity as distinct categories, the new way of studying identity in past societies is to consider the human being as the result of the connection between different types of identities (Díaz-Andreu *et al.*, 2005).

2.2.2 Identity and Material Culture

In archaeology, the personal perception of the identity of an individual who lived in the past cannot be determined. Material culture, however, represents an important source of information in understanding group identity, as it reflects social relationships, actions, and negotiated interactions among human beings and groups (DeMarrais, 2004; Díaz-Andreu and Lucy, 2005). According to Bourdieu and Wacquant (1992), the expression of identities is the outcome of shared habitual and ritual practices and it is communicated through material culture. Cultural objects, such as dress and ornaments, can be seen as a medium through which identity and belonging are expressed. Dresses, for example, besides having the fundamental role of protecting people from different weather conditions, gives information about the wearer, the individual or the family identity, and it can highlight association to a particular social group (Sørensen, 1997; Rothe, 2012; Carroll, 2013; Harlow and Nosch, 2014) Written sources, iconography, and representations on pottery, are some of the material source used in archaeology to assume how items were worn and how clothing was used (Harlow and Nosch, 2014). The study of funerary commemoration on the Rhine and Danube frontiers of the Roman Empire shows that tombs reflected changing cultural identities (Carroll, 2013). Similarly, the study of Lomas (2011) on the inscribed stelae from Veneto, and the extensive research on the Daunian stelae by Norman (2011, 2013), where the depicted scenes reflect various aspects of Daunian society, provide important insights into cultural identities and their representation.

The expression of individual identity in burials is not straightforward and a question-based approach is necessary in funerary context analysis. In fact, funerary rituals reflect the practice of the living, the actual burying process and its social meaning, as well as, how the deceased were perceived in life by other members of society (Parker Pearson, 1999; Carroll, 2013; Foulds, 2017). Grave goods may incorporate several meanings, and objects may have been made specifically for ritual purposes and included in the burial or they were used in life; similarly, the clothing worn by the deceased may have been created appositely as a mortuary custom and not worn by the dead whilst alive, or it might reflect the clothing traditions of the community or group (Sørensen, 1997; Joyce, 2008; Harlow and Nosch, 2014; Foulds, 2017). Textiles are not usually preserved in funerary contexts; however, fibulae, ornaments and other metal objects related to dress accessories give us insight into the ways in which apparel was attached to the body and which ornaments were selected to decorate the costume (Harlow and Nosch, 2014). The study published by De Cristofaro and Piergrossi (2017) on Etruscan and Latial costumes provides an understanding of the dress used by aristocratic females between the Final Bronze Age and the Orientalising periods during funeral ceremonies. The authors also emphasised the probability of variations among cemeteries regarding the garments and ornaments used, however the meaning inherent in the costume would have probably been the same. Whether the dress for the funeral ceremony was worn by the deceased in life or not, it represents the result of the actively decision of the social community according to roles accepted by the group.

2.2.3 Gender Identity

The study of gender identity in ancient cultures has been the focus of recent archaeological research. Gender is a socially constructed cultural phenomenon which refers to an individual's self- identification, and how he/she is perceived by other members of society, based on different gender categories established in their cultural context (Sørensen, 1997). This means that gendered aspects and roles recognised by a society might not be the same in a different society. Under this framework, gender can be seen as a phenomenon that is neither static nor stable, but dynamic and constantly re-negotiated by members of society (Sørensen, 1997; Diaz-Andreu and Lucy, 2005; Sofaer Derevenski, 2006).

2.2.3.1 Gender and Burial Evidence

In funerary contexts, gender is studied through the observation and analysis of material culture, in relation to the data provided by the analysis of the buried body (Diaz-Andreu and Lucy, 2005). Gender must be viewed as distinct from biological sex, an issue which is a recurrent topic of scholarly discussion. The focus on distinguishing between biological sex and cultural gender was not developed before the pioneering article by Conkey and Spector (1984). The increasing consideration of osteology in the field of archaeology has clarified how problematic it is to sex the individual in a grave without considering the osteological data. The biological investigation of the skeleton facilitates the comparison of the physical characteristics of the buried person and the culturally constructed aspects of gender. Scholars highlight that this relationship should not be determined *a priori* but must be questioned and investigated to avoid the easy association between biological sex and gendered grave goods, because this correlation is not always obvious (Lucy, 1996; Sørensen, 1997; Whitehouse, 2001; Diaz-Andreu and Lucy, 2005; Whitehouse, 2006). Burials usually do not represent the perfect scenario in which gender characteristics are easily visible. Traditionally, jewellery and weapons have been often accepted as true indicators of biological sex, the former for females and the latter for males. In reality, there are mortuary assemblages in which no grave goods or gendered items are present (Lorrio and Zapatero, 2005), or a skeleton of one sex is inhumed with grave goods associated with the opposite sex (e.g. burial 155 in Baza Necropolis, Granada Spain, 5th-4th centuries BC, Dommasnes *et al.*, 2010).

The study of gender by Italian archaeologists is at its early stage. However, several studies confirm the presence of an intricate picture in terms of gender distinction within funerary contexts. Research conducted by Toms (1998) on Villanovian tombs from the sites of Veio and Tarquinia, by Bietti Sestieri (1992) at the cemetery of Osteria dell'Osa, and by Vida Navarro (1992) on the tombs of the Picentino assemblage at Pontecagnano, reveal that the association between females inhumed with spinning or weaving objects and male individuals buried with weapons or armour can be maintained and verified. However, in many burials, no gendered objects were present, while in others male and female objects were both part of the assemblage, as the case of razors and spindle-whorls present in the same inhumation in the Villanovan cemetery (Bietti Sestieri, 1992; Toms, 1998; Walton Rogers, 2007). Knives and axes were not exclusive to male burials, while ornaments showed a varied pattern but mainly were associated with female or probably female individuals (Toms, 1998). At Pontecagnano cemetery, Vida Navarro (1992) claimed that the expected pairing men/weapons versus female-spindle-whorls was only verified in some cases.

The research conducted by Scopacasa (2014a) on the ancient Samnite cemetery of Campo Consolino is an example of the study of gender relations and social practice in the light of re-evaluating the analysis of grave goods in Italy. This cemetery was chosen because of the good documentation of the site and anthropological analysis conducted on the skeletons. Statistical tests were run, and correlations between artefacts and sex were established. The analysis of grave goods in association with biological sex led the author to reconsider gendered social relations in this community. Men were not associated primarily with weapons or warriors, but with activities related to commensality and the household, which are often attributed to women. In a later publication of Scopacasa (2014a), age and status parameters were included in the analysis of gender, in addition to sex and grave goods. Results showed some associations between men and weapons and between women and ornaments, however the data suggested the existence of gender fluidity and probable equality in Samnium, with women probably engaged in commensal politics. Those scenarios are an example of the multidimensionality and complexity of the gender sphere.

2.2.3.2 Gender and Age

Given the complexity and multidimensionality of gender, individuals in the funerary context cannot be engendered without taking into account the aspect of age. Gender, as previously said, is not innate, but it is acquired through the life-course and modified on the basis of the roles and culture defined by a society. Hence, gender ideology and gender roles change with the age of an individual and in accordance with the cultural construction of the community (Sofaer Derevenski, 2000; Diaz-Andreu and Lucy, 2005; Sofaer Derevenski, 2006; Gowland, 2007; Sánchez Romero, 2009). Recent studies on gender-age relationship showed that grave goods vary in number and typology according to the age of the deceased and the role/activity within society (Lucy, 1998; Stoodley, 1999). Several considerations are necessary when gender-age relationships in the funerary context are studied. The separation between gender and sex must be maintained, yet there are limitations to estimating sex when the skeleton is not fully mature or in very advanced years (Gowland, 2007). Similarly, there are problems in the chronological age estimation due to the limited ability of skeletal ageing to reflect the chronological age of the individual; this can have an impact when age is viewed as an aspect of social identity (Gowland, 2007).

2.2.4 The Study of Social Diversity

The recent approach to the study of social status and hierarchy is oriented towards the consideration of status as an additional aspect of individual social identity. Hence scholars believe that its analysis should be complemented by other characteristics of the human being, such as health, disease, and the cultural context (Hubert and Hubert, 2001; Cuozzo and Guidi, 2013; Saracino *et al.*, 2018). For many years, limited consideration was placed on who produced and used the artefacts and their potential meanings. As Carr (1995) noted, a holistic and multidisciplinary contextual approach is necessary to be able to potentially interpret the social status and the social persona in funerary practices.

2.2.4.1 Social Status and Burial Evidence

The new theories on social status and roles in past societies follow the post-processual archaeological theory. Post-processualists rejected the simplistic functional explanation of cultural practice provided by processualists such as Binford (1971) and Tainter (1978). Post-processualists stress the importance of the relationship between individuals and society and the role that material culture plays in shaping social structure (Miller, 1982a; Giddens, 1984). In addition, Miller (1982b) argued that people assign meanings to objects and these objects are categorised according the natural environment. Parker Pearson (1982) and Shanks and Tilley (1982) stressed the ideological aspect of funerary practice and rejected the view that grave goods reflect the role of individuals within the society. According to them, burial practice is manipulated by social constructs and represent the consequence of the relationship between the living and the deceased.

The complexity in the study of social status in funerary contexts relates to the pitfalls of assigning modern values to ancient objects, and the assumption that materials in the past held the same value as they do in modern society. Status defines a person's position in the social hierarchy, and status differences are based on an unequal distribution of wealth and power within societies (Babić, 2005). In archaeology status can be expressed through funerary architecture, clothes, ornaments, and artefacts, therefore it is assumed that larger and richer burials might represent wealthy individuals. However, this is not universal to all kind of societies and it is important to consider also the symbolic association that certain materials held (Parker Pearson, 1999). Grave goods may be included in burials for several reasons; they may reflect the wealth and power of the deceased or be gifts from the mourners. Parker Pearson (1999, p. 84) stressed that grave goods in burials are the "[…] culmination of a series of actions by the mourners to express something of their relationship to the deceased as well as to portray the identity of the deceased". Following his argument, during funerary ritual the status of the deceased and of those burying the deceased is manifested.

In addition to grave goods, the space and the distribution of the burials may symbolise the inequalities and status differences among individuals as seen in Iron Age cemeteries from central Italy, where mound burials were associated with wealthy individuals (Acconcia and D'Ercole, 2012; Faustoferri, 2016). Current archaeological theories, however, are cautious in linking tomb characteristics with the social status of the deceased, encouraging a broader analysis of the strategies of social identification through the development of funerary rituals, ideology and landscape, and grave form (Ashmore and Knapp, 1999; Parker Pearson, 1999). The awareness that social status in funerary rituals is not straightforward and easily determined has led scholars to investigate other features (e.g. age, sex, and health) that may reflect the status of the deceased and can contribute to the understanding of social status of past populations (Goodman, 1998; Craig-Atkins and Buckberry, 2010; Knipper *et al.*, 2014).

2.2.4.2 Relationship between Social Status, Age, Sex, and Health

Social hierarchy, class stratification, sexual or gender-based division, and biological status are all interconnected. In bioarchaeology, several studies are suggesting a combined approach to interpret social status in past societies by observing it through many lenses, from the funerary ritual to sex, age, and health of the individual (Larsen, 1997; Goodman, 1998; Robb *et al.*, 2001; Zvelebil and Pettitt, 2008, 2013; Saracino *et al.*, 2018). There is growing evidence to suggests that health and well-being may have varied in relation to social status. Larsen (1997) gives an overview on how status inequality impacts on food and dental health. The author showed that there are contrasting patterns in terms of the high prevalence of carious lesions. In a Medieval population in Hungary, high status individuals had higher prevalence of caries compared to lower status, whereas in Sweden, dental caries were present regardless of social rank. The data from dental health, as well as infectious disease, prompt us to investigate differential access to food and the variability in behaviour within social groups. Similarly, Peck's (2013) research on Middle Iron Age Britain demonstrated that inequality was probably present among the Arras community due to disparities in health even though a social hierarchy was not marked.

A recent case study with a nuanced approach to an Anglo-Saxon cemetery in Raunds Furnells demonstrated that combining funerary rites and biological data has great potential in investigating the social status of past populations (Craig-Atkins and Buckberry, 2010). The authors showed that a clear stratification in burial rite was present and this inequality was visible in the osteological record; people who suffered more from physical stresses were the ones buried with less grave goods. The research by Saracino *et al.* (2018), investigated social exclusion and marginality in Early Bronze Age and Iron Age Veneto and South Tyrol. The authors combined burial features, such as anomalies and differentiation in funerary rites, body treatment, scarcity of grave goods, and unusual tomb structures or burial placement, with biological data. Their results showed that aspects of social inequality and hierarchy were recognisable from the different funerary practices adopted in the Iron Age Veneto. However, at the same time, forms of social integration observed on the basis of age, sex, and health status of the deceased, were visible from the osteological record. A less clear picture was seen in the South Tyrol cemetery. Bioarchaeologists are broadening their understanding of health within hierarchical societies by acknowledging that inequality is culturally embedded (Gowland, 2017). Gowland (2017) stated, on the basis of clinical studies, that when a situation of social inequality persists for generations it can lead to an alteration of the normal biological processes, resulting in biological alterations across generations. These studies show how complex and non-linear the link between health and social status is, and that the two do not often correlate.

Chapter 3 Archaeological and Bioarchaeological Studies in Italy

3.1 Overview of Funerary Contexts in Pre-Roman Central and Central-South Italy

Italy is characterised by a variety of landscapes, which are the result of the long-term evolution of its geology and of its temperate climate, to which human activity contributed by shaping the environment hence allowing the development of different cultures through time (Soldati and Marchetti, 2017). The physical landscape of the country played an important role in promoting or inhibiting the formation of settlement patterns, socio-economic networks, and cultural interactions (Isayev, 2007). The sheer volume of information that helps us to investigate and explore the cultural links established by the communities inhabiting the Italian peninsula during the pre-Roman period comes primarily from the funerary context. However, cemeteries rarely represent the whole strata of the society, as formal funerary practices were frequently selective processes restricted to upper social classes (Cuozzo, 2016; Saracino *et al.*, 2018).

This chapter provides a brief overview of the major funerary contexts excavated both in regions neighbouring with Abruzzo and in Abruzzo itself (Figure 3.1) (sections 3.1.1 and 3.1.2), to offer a wider perspective for understanding the cemeteries analysed in this thesis (Nocciano, Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, Spoltore-Quagliera, Pescara). The description of these cemeteries also provides the reader with a background that highlights cultural links, were present, among selected communities of Central and Central-South Italy, which is an evidence of the non-strict social boundaries during the pre-Roman period and in this area of Italy. Yet, micro regional differences may be visible occasionally. This chapter (section 3.2) also gives an overview of bioarchaeological studies conducted, mainly in central Italy, in recent years, which highlight the lack of biocultural studies and the need for more. A more detailed analysis of five major cemeteries excavated in central Italy, with a focus on the analysis carried out on the skeletal remains and the grave goods associated with them, follows in section 3.3. These five sites, considered as reference cemeteries, are key to make parallels and comparisons with the investigated cemeteries in the thesis.

Figure 3.1 Funerary sites in Abruzzo and neighbouring regions discussed in the chapter. 1.Matelica, 2. Numana, 3. Osteria dell'Osa, 4. Gabii, 5. Satricum, 6. Pontecagnano, 7. Termoli Porticone, 8. Larino, 9. Fossa, 10. Navelli, 11. Capestrano, 12. Opi-Val Fondillo, 13. Alfedena Campo Consolino, 14. Bazzano, 15. Campovalano, 16. Atri, 17. Montebello di Bertona and Vestea, 18. Nocciano, 19. Loreto Aprutino-Cappuccini, 20. Moscufo-Via Petrarca, 21. Spoltore-Quagliera, 22. Pescara-Ex Gesuiti. Creative Common licence.

3.1.1 Funerary Contexts in the Regions Bordering Abruzzo

The funerary practice of the populations settled in Abruzzo falls within a generalised cultural trend present in Central and Central-South Italy from the Iron Age. The adoption of individual inhumations and the placement of items in the burials were a common practice shared among several communities in this area of Italy. Although, subtle differences in the spatial distribution of the burials or in the selection of the burying process, such as in limestone cists, in simple *fossae*, or covered with wooden boards, were evident among cemeteries. These differences were detectable within single cemeteries and between cemeteries in Central and Central-South Italy (Rajala, 2016; Tagliamonte, 2017). Therefore, in this section, several archaeological sites excavated in the regions bordering Abruzzo are described to provide a wider picture for a broader discussion regarding cultural similarities and differences in the funerary contexts of these pre-Roman populations.

Archaeological surveys conducted in the past years in the Marche region, north of Abruzzo, shed light on the distribution of the vast number of pre-Roman cemeteries existing in the area. Important sites developed inland along major communication routes, such as Matelica and Moie di Pollenza (province of Macerata), as well as in the proximity of the Adriatic coast, as for example Colle del Cardeto and Numana (province of Ancona) (Naso, 2000). The cemeteries at Matelica, located in the heart of the Apennine chain, showed long continuity of use from the Iron Age to the 6th century BC, yet the period that followed (5th-4th centuries BC) returned a fragmented picture (Casci Ceccacci and Biocco, 2020). The long continuity of use of the cemetery was also observed in several sites in the Central Italy, such as in Abruzzo (at Fossa and Campovalano) (Cosentino *et al.*, 2001; D'Ercole, 1996; D'Ercole and Benelli, 2004). The section of the cemeteries at Matelica, dated to the 7th century BC, consisted of tumuli and circles of burials with the main inhumation placed at the centre of the tumulus and the later burials within the perimeter of the tumulus. The archaeological evidence showed that the individuals were inhumed in single *fossa* burials covered with wooden boards (Biocco and Sabbatini, 2008). This practice was also observed at Numana (Delpino *et al.*, 2016). The section of the site at Brecce, one of the cemeteries excavated at Matelica and dated to the 5th-4th centuries BC, displayed burials arranged in two clusters. The majority of the individuals buried were adults and only four sub-adults were recovered (Casci Ceccacci and Biocco, 2020). The individuals were buried in a crouched position, a practice that was observed at Numana and in most cemeteries of the Marche region, however unknown in other area of Central Italy (Naso, 2000). According to Casci Ceccacci and Biocco (2020), the funerary rituals in the Marche region in the 6th-4th centuries BC appeared to be uniform with a standard set of grave goods, consisting of ornamental objects, combat-related items, and the frequent presence of an *olla*, a storage vessel.

The cemeteries at Numana, located in the mid-Adriatic coast, in the south-west area of the Conero promontory in the Marche region, provide additional evidence to reconstruct the funerary practices adopted by the populations inhabiting this area. Several cemeteries were excavated at Numana, dating from the Iron Age and Archaic to the Hellenistic period, some of them with a long continuity of use, such as Via delle Vigne (6th-5th centuries BC); I Pini (end of 6th century BC); Quagliotti-Davanzali (9th-2th centuries BC) and Via Montalbano (6th-4th centuries BC) (Finocchi and Baldoni, 2017). The Quagliotti-Davanzali cemetery constituted the widest cemetery known to date in this area of Marche (Delpino *et al.,* 2016). It provided more than 500 burials dated between the 9th and the 2nd centuries BC. Very little was published regarding the distribution of the burials and the funerary contexts. Delpino *et al.* (2016) reported that the burials were following a discontinuous pattern (Figure 3.2); those situated in the eastern area of the cemetery were organised following a regular distribution with variable orientation, whilst those in the northern area were oriented following a similar direction. The burials were organised in circles around empty spaces, as seen in the near cemetery of I Pini, and at Campovalano, in Abruzzo (Naso, 2000; Finocchi and Baldoni, 2017). A diachronic change in the funerary rituals at Quagliotti-Davanzali was observed, the earliest two depositions were cremation (9th century BC), three were monumental burials dated to the end of the 5th century BC, whilst the remaining were all inhumation in simple *fossae.* The *fossa* burials were occasionally constructed with a ledge cut half way up the internal wall of the burial, suggesting the use of wooden boards positioned over the ledge as a form of cover of the body (Delpino *et al.,* 2016). In contrast to other cemeteries in Abruzzo, yet similar to the funerary practice seen at Matelica, at Quagliera-Davanzali the individuals were inhumed crouched on their right sides (Delpino *et al.,* 2016). To date, palaeodemography and the analysis of the skeletons has not been conducted (Finocchi and Baldoni, 2017) and very little is published regarding the funerary context and the grave goods at this site (Percossi Serenelli, 1998; Landolfi, 2009). However, there is evidence of the use of a shroud to cover the bodies, indicated by the recovery of a line of small rings and two fibulae positioned on the side of the deceased, and the grave goods were usually positioned in a niche cut near the feet of the individual (Naso, 2000; Delpino *et al.*, 2016; Finocchi and Baldoni, 2017).

Figure 3.2 Spatial distribution of the burials in the Quagliotti-Davanzali cemetery. Modified after Finocchi and Baldoni, (2017).

Among the vast number of archaeological sites present in the Lazio region, Osteria dell'Osa (province of Rome) is considered the main Iron Age cemetery that has been excavated to date (Bietti Sestieri, 1992). A total of 600 burials were excavated and they provided useful material to study gender expression in burials and social stratification (Bietti Sestieri, 1992). The spatial organisation of the burials changed from the Latial phase II (900-770 BC), characterised by a neat arrangement of burial groups, to the phase III (770-720 BC), characterised by a single cluster with a disorganised and crowded layout of the burials (Bietti Sestieri, 1992). The funerary evidence from Latial phase II suggested the presence of two groups with a simple social structure based on kinship, while in the later Latial phase III (770-720 BC), Bietti Sestieri (1992) identified and interpreted a separate group of burials as a possible aristocratic elite group. According to the author, the common type of burial of Latial phase IIB (740-730/20) was a large trench comprising a lateral niche, containing the grave goods, which was dug on one of the long sides of the burial. The Iron Age grave goods consisted of a variety of hand-made vessels, spindle-whorls, and reels, as well as bronze fibulae, glass paste beads, razors and combat-related objects (Bietti Sestieri, 1992).

The Archaic period in *Latium vetus* was characterised by the diminishing of grave goods. This was evident at Gabii (near Osteria dell'Osa, province of Rome), in the section of the cemetery identified as area D and dated ca 525-400 BC (Evans, 2018). In contrast to Osteria dell'Osa and other cemeteries in central Italy, at Gabii the number of burials excavated was unexpectedly low. A total of seven inhumations, consisting of juveniles and adults, were retrieved. No infants were found in the area D of the cemetery (Evans, 2018); however, two infant burials were excavated in the area A dated to the early Iron Age (Becker and Nowlin, 2011). The burials in the area D consisted of trenches containing a niche curved on the side of the burial and were devoid of grave goods. The absence of grave goods impeded the evaluation of the social structure of this group of individuals. Although, the distribution and location of the cemetery suggested that these individuals could have been of high social status (Evans, 2018).

The funerary practice observed in the area south of Abruzzo, in the Biferno valley in Molise, consisted primarily of inhumations, however from the 5th century BC, cremations were found alongside inhumations at Samnium (Scopacasa, 2015). At Larino (province of Campobasso), the practice of cremation consisted of placing the ashes into cinerary urns and buried with a high number of grave goods including imports from Etruscan-Campanian and Daunian areas (Tagliamonte, 2017). The cemeteries in the Biferno valley presented a less organised pattern and a low number of inhumations (Barker and Suano, 1995). At Termoli Porticone (province of Campobasso), the 69 excavated burials dated to the 6th-4th centuries BC were not oriented following a recognisable pattern (Scopacasa, 2015). They were simple trench cut backfilled with cobbles and soil, with the bodies laid supine with arms and legs fully extended (Barker and Suano, 1995). This funerary practice finds parallels with several small cemeteries in Abruzzo, as it is described hereafter (section 3.1.2). On the spatial distribution of the burials, Scopacasa (2015) suggested that the lack of a centre and a clear burials' organisation may be a testament of an equalitarian society, which was prone to minimise the emphasis in the expression of social differences among the deceased individuals. The grave goods consisted of local and imported pottery, mainly from Daunia, in northern

Apulia; spears and knives were the most frequent objects in burials considered of male gender (the biological sex was not estimated), while pendants, rings and beads of glass paste were found in burials considered of female gender.

After focusing on the areas surrounding Abruzzo, it is worth describing the funerary practices carried out in the region. The following section describes in detail the funerary contexts excavated in Abruzzo, within large and small cemeteries, setting the scene for the introduction to the sites examined in this thesis.

3.1.2 Overview of the Funerary Contexts in Abruzzo

The panorama of the Abruzzo region concerning pre-Roman funerary contexts appears as an articulated system. The number of archaeological excavations and surveys undertaken in selected areas of the region (e.g., Fossa, Bazzano and Alfedena), as well as the number of studies conducted on the archaeological sites, increased in the last years providing a clearer indication of the distribution and organisation of cemeteries in those areas. As a result, the level of knowledge of funerary practices and of the communities inhabiting those territories has increased. Yet, other areas of Abruzzo still remain widely understudied and more research is required to provide a better picture of the region in pre-Roman times.

Some of the main sites to date, in terms of number of burials, were recovered in the hinterland area of Abruzzo, which is characterised by the orographic discontinuity of valleys, upland and mountains. Here, smaller cemeteries have also been excavated close to the main sites, though the period when the former were active did not necessarily overlap with the latter sites (Acconcia and Ferrari, 2015). The period of use of the cemeteries varies according to the site location, a pattern that was evident in the assemblages situated in the county of L'Aquila. Assemblages on the summits such as San Lorenzo at Barisciano, Campo Rosso at San Pio delle Camere, and Campo di Monte at Caporciano were used for shorter periods, between the 8th century BC and 6th century BC (D'Ercole and D'Alessandro, 2007), while those on the valley were characterised by a continuity of use from the Iron Age to the Roman period (D'Ercole, 2010). Fossa, Bazzano, Cinturelli-Caporciano, and Capestrano are among the cemeteries that present evidence of continuity of use from the Iron Age (800 BC) to the Roman period (c. AD

100). Fossa is located in the upper Aterno basin and consisted of approximately 600 burials; Bazzano cemetery is located in the L'Aquila plateau and encompassed 1672 burials; Cinturelli-Caporciano contained 250 burials; Capestrano contained 300 burials (Cosentino *et al.*, 2001; D'Ercole and Copersino, 2003; D'Ercole and Benelli, 2004; Acconcia, 2014; Weidig, 2014). Acconcia and Ferrari (2015) proposed a diachronic analysis of the structure of the cemeteries developed in the Abruzzo region and grouped them in two different groups depending on the lines of formations. The first group was defined as without a planned order and was characterised by an apparently haphazard use of the cemetery, with later tumuli and *fossa* burials built in the empty spaces left between earlier tumuli without a particular organisation. Within this group, the burials did not seem to be organised according to the gender or age of the individual (Acconcia and Ferrari, 2015). The second group, instead, was characterised by an organisation of the burials around the pre-existed tumuli with clusters of burials distributed following a specific plan. Additional details on the structure of each cemetery will be given within the correspondent section, in the following pages.

A more fragmented picture arises from the smaller cemeteries and those not located in close proximity to bigger cemeteries (e.g., Atri, Loreto Aprutino and Pescara). Surveys conducted on the area towards the Adriatic coast of Abruzzo showed the presence of a dense configuration of settlements and a high number of small cemeteries gravitating towards medium to small sized settlements (D'Ercole and Martellone, 2003a). However, the non-uniformity of excavations and the difficult accessibility of the data has led to a fragmented understanding of the distribution of the cemeteries east of the Gran Sasso mountain

3.1.2.1 L'Aquila Plain

3.1.2.1.1 Fossa

The cemetery of Fossa was intensively surveyed and studied since 1992 and the findings were published in three volumes and several articles (Cosentino *et al.*, 2001, 2003; D'Ercole and Copersino, 2003; D'Ercole and Benelli, 2004). The cemetery was organised without a planned order, with later burials placed within the empty spaces left by earlier tumuli (Figure 3.3) (Benelli, 2008). The typology of the tumuli varied diachronically up to the first half of the 6th century BC, when they were substituted with the *fossa* burials (Acconcia and Ferrari, 2015). Moreover, their typology seemed to reflect the gender and age of the individual inhumed in them; for example, in the Iron Age and Orientalising phases, the tumuli were covered with a dome made of stones appeared to be intended for women and children, whilst in the 7th century BC this structure appeared to be selected for adult males. Between the 7th and the 6th century BC, this structure did not seem to be designated to a particular gender or age, plus the presence of monumental burials not as rich as in the previous centuries, and a standardisation of the grave goods were observed (D'Ercole and Benelli, 2004; D'Ercole and Martellone, 2008; Acconcia, 2014). The individuals buried in the cemetery of Fossa were studied via anthropological and archaeological analyses. A total of 100 individuals belonging to the Orientalising-Archaic and Hellenistic periods from this cemetery were included in a study focussed on changes in skeletal properties related to behavioural and social patterns using a bioarchaeological approach (Sparacello, 2013). A smaller sample (88 individuals) was included in a study that investigated the relationship between social factors and human growth (Sparacello *et al.*, 2017). Male individuals were usually buried with swords, dagger, and spears, while female individuals were buried with personal ornaments and spindle whorls. The niche (*ripostiglio*) was present in both male and female burials. New-born babies were buried within roof tiles with no grave goods, while individuals under the age of 1 were buried in *fossa* grave with grave goods, and individuals around the age of 4 were buried with grave goods similar to those of adults. The *olla* was included in the burials of individual older than 10 years of age (Benelli, 2008).

Figure 3.3 Layout of the main section of the cemetery at Fossa. Modified after Acconcia, (2014).

3.1.2.1.2 Navelli and Capestrano

The information provided for the cemeteries of Navelli and Capestrano is primarily extracted from the works published by Acconcia (2014) and Acconcia and Ferrari (2015). Located south east of Bazzano, in the L'Aquila area, the cemetery Il Piano was excavated in the 2013 and 2014 on the Navelli upland (D'Ercole, 2014a). To date, the cemetery returned 98 burials cut on a soil formed by sandstone and levels of clay deposits. The cemetery was in use from the 7th century BC until the Hellenistic period (Di Sabatino *et al.,* 2014a). The *fossa* type burials were organised in circle around earlier female burials. Larger and deeper adult burials belong to the 7th and 6th century BC with the individuals in those burials inhumed into carved logs (Acconcia and Ferrari, 2015). Infants, children, and juveniles represented 70% of the burials found in the cemetery. Individuals age 0-2 months were inhumed into roof tiles with no grave goods, whilst infants and children were buried with objects such as *fibulae*, *armillae*, rings (Di Sabatino *et al.,* 2014a). The funerary ritual for the adult individuals was limited to a small number of objects, a few personal ornaments, the *ripostiglio* and the *olla*. Male burials also included weapons and occasionally razors, while females were buried with spindle whorls and bronze belts (Acconcia and Ferrari, 2015).

The cemetery of Fontanelle-Capestrano, located 7 km east of Navelli, was excavated in 2012 and returned 55 burials dated from the 7th to the 2nd century BC. The burials were organised to form circles (end of 7th century BC – mid 6th century BC) or in parallel lines (end of 6th century BC – beginning of 5th century BC) (Di Sabatino *et al.*, 2014b). Adults and sub-adults were inhumed in simple *fossa* burials, while neonates were inhumed within roof tiles. The funerary ritual belonging to the Orientalising and Archaic periods did not differ from the one adopted in the cemeteries of the L'Aquila area previously described. A *ripostiglio* with the *olla* surrounded by stones and ceramic and bronze vessels was present in the adult burials of the end of 6th and beginning of 5th century BC; males were buried with weapons, spits, and a few personal ornaments, while females were buried with personal ornaments, but not spindle-whorls. A few bioarchaeological studies on the skeletons from Navelli and Capestrano were published recently (Sparacello, 2013; Cesana, 2014; Sparacello *et al.*, 2014, 2017). Recent chemical analyses of the residues in the *ollae* from the cemeteries of Capestrano, Bazzano, and Cinturelli revealed the presence of an alcoholic substance obtained from the fermentation of fruits mixed with resin (Menozzi and Acconcia, 2017). This represents an interesting discovery since most of the information on dietary habits of the populations inhabiting this area comes from literary sources, and only limited research has been conducted on this topic (Staffa, 2010; Menozzi and Acconcia, 2017).

3.1.2.1.3 Opi—Val Fondillo

The cemetery located in the Fondillo Valley, near the modern town of Opi, about 24 km north-west from Alfedena, was excavated in 1994-1997 (Morelli, 2000). About 180 inhumation burials were excavated, all dating from the 7th to the 3rd centuries BC. The burials were placed in parallel lines and organised in circles (ten in total) with an empty space in the middle, as seen for Alfedena (Figure 3.4) (Acconcia, 2014; Acconcia and Ferrari, 2015). It was hypothesised that those circles were once tumuli (Faustoferri, 2003). The burials were of simple *fossa* or of cist type covered with lithic slabs. Following the anthropological analyses of the skeletons, burial type, and grave goods, no rigid organisation of the burials within the circles was identified according to sex or age of the individuals (Luttikhuizen, 2000; Faustoferri, 2003; Acconcia, 2014).

Figure 3.4 Layout of the cemetery at Opi-Val Fondillo. Modified after Acconcia, (2014).

In the cemetery at Opi Val Fondillo, not all the individuals were buried with grave goods and, in fact, a third of the burials contained only fibulae while a small number were inhumed without burial items. In burials where grave goods were present, vessels, ornaments and weapons were the main items found; males were buried with combat items, such as daggers, a short sword, or spearhead, while females were buried with rich ornaments and occasionally, with spindle-whorls (Acconcia, 2014). The *olla* and the *ripostiglio* were retrieved in burials of both sexes and, occasionally, in infant burials as well. The *olla* was positioned on top of the lithic slab used to cover the burial, as seen at Alfedena, or at the same level of the inhumed body (Faustoferri, 2003). In depth studies regarding the cemetery of Opi Val Fondillo are not available, though a few research projects were conducted on the skeletal remains. Osteological analysis was carried out on 47 skeletons, where sex and age at death were estimated (preliminary data) (Luttikhuizen, 2000). Also, a small number of specific analyses were conducted by Viciano *et al.* (2015) on odontometric sex estimation of 99 individuals. The research by D'Anastasio (2008) and Viciano *et al.* (2012) meanwhile, focussed on investigating traumatic dental injuries and perimortem weapon trauma, respectively.

3.1.2.2 From the Gran Sasso Mountain to the Adriatic Coast

This section comprises both cemeteries that are not under study in this thesis (Atri, Montebello di Bertona and Vestea) and the cemeteries that are under study (Nocciano, Loreto Aprutino, Moscufo, Spoltore and Pescara). The reason why the sites are presented together in this section is that they are located in close proximity to each other.

3.1.2.2.1 Atri

The cemetery La Pretara is located 2 km south-east from Atri, situated near the Vomano River, and consisted of 35 burials in total. The burials were organised according to three distinct groups and were all dated to the 7th century BC (Ruggeri, 2001). The deceased were inhumed in simple shallow *fossa* burials with the arms along the body or over the pelvis. The skeletons were sexed and aged according to the type of grave goods present in the burial and to the dimension of the burials, however no osteological analyses were conducted on the skeletons (Ruggeri, 2001). The analysis of the grave goods indicated that there was a clear distinction between the sexes and that the status of the individuals was not clearly expressed by the funerary ritual (Luttikhuizen, 2000). Individuals classified as adult males were buried with elements resembling the "warrior" figure, such as swords, daggers, spears, and razors. In contrast, individuals classified as adult females were buried with personal ornaments, *fibulae*, and objects related to spinning and weaving (Acconcia, 2014). It must be acknowledged, however, that without the osteological analyses of the remains, further investigation is required before definitively concluding that there was a clear distinction between the sexes in terms of the grave goods associated to them.

3.1.2.2.2 Montebello di Bertona and Vestea

The area including the Saline and the Pescara rivers has returned a variety of cemeteries that dated mostly between the 6th and the 4th century BC. The funerary contexts have been marginally published and very little archaeological and bioarchaeological research has been conducted when compared to the cemeteries previously presented in this section, such as Campovalano, Bazzano, Fossa, and Alfedena. The main cemeteries presented below include a few sites in the piedmont area, east of the Gran Sasso Mountain, and along the Adriatic coast at the level of the Pescara river mouth.

Beginning from the hinterland, the cemetery at Montebello di Bertona-Campo Mirabello was excavated between the 1952 and the 1956 (Riccitelli, 2003). A total of 161 burials were retrieved, dating between the 6th century BC and the Republican period. There are very few excavation reports for this cemetery, while only a fraction of the material retrieved in the cemetery survived and the location of the skeletal remains is uncertain. All burials were inhumations except for one which was a cremation. The individuals were laid supine in simple *fossae*, in *fossae* with ledge along the perimeter of the internal *fossa,* or in *fossae* backfilled with stones. Of the burials, 10% did not include grave goods, and the *olla* and *ripostiglio* were placed near the head or near the feet of the deceased. The grave goods present in other burials included pottery, personal ornaments made of bronze, glass paste, amber for what have been defined female burials, while combat elements were included in male burials. Another cemetery was found at Vestea-Colle Quinzio (Pescara county), located 4 km south of the Montebello di Bertona cemetery. A total of 12 burials were unearthed dating from the archaic and Hellenistic periods. Very little is known about this context, and the burial structure differs in complexity compared to the above presented cemeteries. No osteological analysis was conducted on the skeletons (D'Ercole and Martellone, 2003b).

3.1.2.2.3 Nocciano

The cemetery of Nocciano is located 28 km west of the mouth of the Pescara River, about 228m above sea level (asl). The first excavation of the cemetery was conducted between 1971 and 1973, and nine inhumation burials dating the 6th – 5th centuries BC were discovered (de Pompeis and Paolini, 1980). A different sector of the cemetery was excavated in the years between 1974 and 1981, with the revelation of three additional burials. The last field work campaign, from 1985 to 2002, involved the excavation of the ancient Italic settlement, SW of the main group of graves. According to the archaeological report, the origin of the settlement falls between the end of the Bronze Age and the beginning of the Iron Age (7th-6th centuries BC) (Franchi Dell'Orto, 2010).

The burials presented a scattered distribution, with the main group of five graves located NE of the settlement. The burials were not oriented following a similar orientation, showing that there was neither a predominant orientation nor a specific pattern of distribution. The individuals were buried supine in *fossa* burials. The bodies were placed directly on the ground or over a mat made of vegetable fibres, which were retrieved from the base of the burial (de Pompeis and Paolini, 1980). In this cemetery, one or two large slabs were used as a cover for the burials of both adults and infants. The use of slabs is rarely attested in the Abruzzo funerary assemblages, whereas it is attested for infant burials in the Lazio region (Weidig, 2014). No information is available on the analysis of the skeletal remains.

3.1.2.2.4 Loreto Aprutino

Surveys and field excavations conducted at Loreto Aprutino, about 25 km west of the mouth of the Pescara river, 230m asl, brought to light several small cemeteries and settlements. Findings have been published for some of the better-known cemeteries including Farina-Cardito, Casone-Colle Fiorano, PEEP1, Corolongo, and PEEP2. The latter three sites had been identified by the archaeologists as one large cemetery under the name of Loreto Aprutino-Cappuccini (Staffa, 2003a). The cemetery at Farina-Cardito was excavated in 1957 and a total of 19 burials were excavated belonging to the 7th – 6th centuries BC (Papi, 1978, 2014). Past studies on this cemetery focused on the description of the funerary context and the grave goods. Female burials (sexed based on grave goods) displayed a rich and varied set of objects and ornaments compared to the male burials, which were inhumed mainly with weapons and without an articulated set of pottery for the banquet (Staffa, 1998; Papi, 2014). Two female individuals were inhumed with amber, bronze *armillae*, bronze fibulae near the head, a decorated bronze belt, and a diadem placed around the head (Staffa, 1998, 2010). One of these individuals had a breastplate made of small iron chains and two necklaces, one of which was made with glass paste beards and amber. In the two burials were also recovered objects related to dining (small carinated bowls, small amphorae of Sabine provenance, *oinochoai* imported from Etruria, and a *kylix*). Spinning activity was suggested based on the large number of reels and spindle-whorls present in the burials. Scholars interpreted the cemetery in Farina-Cardito as a family group, where females might have been in charge of representing the power and status of the family (Staffa, 1998, 2010; Papi, 2014). More research, however, would be necessary to validate these suggestions. The site at Casone-Colle Fiorano, located in the vicinity of the major cemetery Loreto Aprutino-Cappuccini, was excavated in the 1950s and again in the 1990s, and 23 burials were unearthed dating to the Archaic period. This cemetery, as the previous one, lacks information on the distribution of burials, as well as an osteological analysis of the skeletons. The funerary ritual does not differ in terms of typology of object placed in the burials compared to the burial at Farina Cardito (7th century BC), however it appears less articulated.

The cemetery Loreto Aprutino-Cappuccini (Loreto Ap.-Cappuccini) consisted of three scattered inhumation areas (PEEP1, Corolongo and PEEP2), and it was one of the five cemeteries included as material of study in the current PhD research. A total of 64 burials were excavated from the cemeteries PEEP1 (seven burials), Corolongo (six burials), and PEEP2 (51 burials), which were grouped and considered as one large cemetery (Staffa, 2003a, 2003b). Based on the diagnostic artefacts found in the cemetery, the burials date to the period between the 6th–4th centuries BC, however most of the burials appear to be from the 5th century BC. The orientation of the burials was not uniform. In PEEP1 they were predominately oriented on an E-W alignment, while in Corolongo the orientation was mainly SW-NE. In the third area, PEEP2, the burials were oriented on a NE-SW alignment. Four burials excavated in 2009 were predominately oriented NW-SE (Di Tommaso, 2009).

Prior to this PhD research, where an in depth bioarchaeological analysis of the human skeletal remains was undertaken, no osteological assessment was conducted on the skeletons retrieved in this area. The analysis of the cemeteries included primarily a description of the funerary ritual and a classification of the grave goods found in the burials. As reported by Staffa (2003a, 2010), the skeletons were buried in supine position with arms along the sides or crossed over the pelvis. The burials were all simple *fossa*, which occasionally had a ledge along the perimeter on the *fossa* where the *olla* was placed. The *ripostiglio* was not always present. The burials were covered with large rocks or delineated by an alignment of rocks. The grave goods found in what have been defined as male burials were standardised with a long sword or dagger, a spearhead, spits, and ceramic vessels among which there was an *olla*. The grave goods in female burials (sexed based on grave goods) comprised personal ornaments such as necklaces, rings, pendants, ceramic and bronze vessels, and occasionally spindle-whorls and reels. Immatures were mainly buried with necklaces, pendants made of amber, glass paste and bone, and a few vessels; the *olla* within the *ripostiglio* was present in burials number 10 and 41 from PEEP2. Similarities were observed between the grave goods of the cemetery of Loreto Aprutino-Cappuccini and the cemetery of Colle Fiorano, in particular for the set of items selected for male individuals. In contrast, grave goods in female burials from Loreto Aprutino-Cappuccini appeared to be more diversified compared to the females from Colle-Fiorano.

3.1.2.2.5 Moscufo-Via Petrarca

The cemetery at Moscufo–Borgo San Rocco, Via Petrarca, excavated in 2008, revealed 24 burials dating from the second half of the 6th to the 5th centuries BC. The burials were mainly oriented on a NE-SW alignment and positioned at different levels. Remains of a small settlement and a ditch were discovered in an earlier phase of excavation (Franchi Dell'Orto, 2010). The limited published data available on this cemetery has hindered a detailed analysis of the site. The funerary ritual at Moscufo Via Petrarca finds parallels with the cemeteries described above, such as Loreto Aprutino-Cappuccini. All burials were inhumations and the individuals were buried supine with their arms along the sides or over the pelvis, and a set of grave goods (Staffa, 2010). Prior to the current PhD research, no osteological or bioarchaeological analysis had been undertaken on the skeletons excavated in the cemetery.

3.1.2.2.6 Spoltore-Quagliera

The cemetery of Quagliera is located 5 km north of the mouth of the river Pescara near the town of Spoltore and has been the subject of two separate excavation campaigns. During the first campaign, two burials dated to the 5th-4th centuries BC were identified and excavated (Staffa and Cherstich, 2009). The second campaign resulted in the discovery of 34 graves located near the previous site. The graves appeared to cluster along the perimeter of the cemetery, a distribution that was explained by Staffa and Cherstich (2020) as the result of the better composition of the ancient soil which allowed the cutting of rectangular graves. The burials were organised mainly in parallel rows, with 30 of them oriented E-W and the head of the deceased toward the east, and with six oriented N-S and the head of the deceased towards the north (Staffa and Cherstich, 2020). The chronology of the cemetery ranges between the 5th century BC and the 4th century BC. The analysis of the burial distributions and the grave goods is still incomplete (Staffa and Cherstich, 2020). Prior to the current PhD research, a bioarchaeological analysis of the cemetery had not been undertaken.

3.1.2.2.7 Pescara-Ex Gesuiti

The cemetery is situated about 3 km NW of the mouth of the Pescara river, 43m asl, in a modern football field called "Campo sportivo Ex Gesuiti". The archaeological site comprises the cemetery and a protohistoric settlement, 2.2 km north of the cemetery (location Colle del Telegrafo). The earliest recorded evidence of a cemetery was due to the discovery, in the years 1938-1943, of several burials east of the Gesuiti church. In 1974, during the refurbishment of the football field, various objects were found, such as a Samnite belt and a bronze grater, all dating between the 5th and the 4th century BC. However, it was not until 1997-98 that a major sector of the cemetery was explored (Staffa, 2001, 2003b). The excavation record mentions 11 excavated burial dating from the 6th to the 4th century BC. According to the archaeological report, the inhumations were grouped in two clusters: two burials were dated to the 6th century BC, while the remaining nine graves were located 60 meters to the west and belonged to the 5th century BC (Staffa, 2001, 2003b).

The graves did not follow a recognisable pattern. Most of the burials were badly damaged by agricultural work and, in addition, the pH and consistency of the soil led to the loss of almost all the skeletal remains, compromising the understanding of the layout of the bodies. The individuals were inhumed in *fossa* burials and their grave goods did not differ significantly from those recovered from the cemeteries of the hilly areas. Female individuals (sexed based on the grave goods) were buried with personal ornaments and a large quantity of vessels, while males with a sword and a spit (or a spearhead and a spit) but with less vessels. The skeleton of a small dog was found buried in a *fossa* grave, but no additional information on the zooarchaeological analysis of the animal is available (Staffa, 2001, 2003b). An osteological analysis was not carried out for the skeletons of this cemetery, due to their extremely poor preservation, and only a few fragmented bones were recovered in total from the burials.

3.2 Current Bioarchaeological and Biocultural Research in Italy

3.2.1 General Introduction

Until relatively recently, funerary archaeologists active in Italy were primarily interested in the study of grave goods or in the structure and decoration of burials, while less or no attention was given to the human skeletal remains to which the grave and the burial goods were associated. The latter facets of the funerary context were subjected to a mere classification and storage without an appropriate study or ethical consideration. Skeletal remains, though, are of great importance because through their analysis it is possible to answer questions about people's diet, disease, health, and behaviour. During the 80's and 90's, in the United States, scholars begun to realise the potential of studying skeletal human remains, and the amount of information gained from their analysis started to be valued. The first book on bioarchaeology, in which the term refers to the study of skeletal remains from an archaeological context, was published in the 1997 (Larsen, 1997) followed by the book published by Buikstra and Becks (2006) where a detailed history of the study of bioarchaeology was documented. In Italy, there is still a long way to go before reaching the level of detail in bioarchaeological research that researchers in the United States and in the United Kingdom have achieved.

Current bioarchaeological studies focus on answering questions mainly regarding palaeodiet, stature, skeletal stress and disease, trauma, activity related pathology, diet, and migration. In recent years there was an increase in the degree of specificity to which these subjects are analysed, due to the development of new techniques utilised to investigate detailed information, such as stable and elemental isotope analysis, palaeoproteomic and ancient DNA analyses. In Italy contextual bioarchaeological studies increased slightly in the last decades resulting in a growing list of published articles. Nevertheless, excavations of mortuary sites where no skeletal analysis is conducted are still observable today.

3.2.2 Brief Overview of Bioarchaeological Research on Infectious Diseases, Diet, Heath, and Biodistance in Italy

For many years, Italian scholars exclusively focused on the documentation of pathological bone alterations as evidence of disease with little or absent archaeological context-based analysis (Fornaciari and Giuffra, 2009; Fornaciari *et al.*, 2012). As mentioned in section 3.2.1, the interest in bioarchaeological research in Italy increased in the last decades. Hence, through these lenses, a series of Italian archaeological sites from the Neolithic (e.g., Sparacello *et al.*, 2017; Parkinson and McLaughlin, 2020) to the Medieval periods (e.g., Vercellotti *et al.*, 2011; Reitsema and Vercellotti, 2012; Fornaciari *et al.*, 2015; Amaro *et al.*, 2019; Santiago-Rodriguez *et al.*, 2019; Smith *et al.*, 2019) were studied, where particular attention was paid to adult individuals. In spite of this, studies regarding the bioarchaeology of childhood, and skeletal conditions affecting pre-adult stage individuals are still very limited (Bisel and Bisel, 2002; FitzGerald *et al.*, 2006; Prowse *et al.*, 2008; Reitsema *et al.*, 2016; Goude *et al.*, 2020). Recently, a volume on the archaeology of infants and children in Pre-Roman Italy was published including papers about methodological and theoretical approaches to the bioarchaeological study of young individuals in ancient Italy, as well as a collection of research conducted on this subject and organised by geographical areas (Tabolli, 2018). This section summarises the most relevant bioarchaeological works undertaken on pre-Roman and Roman populations in Italy.

Evidence of infectious diseases, such as tuberculosis or leprosy, are rare in Italy. The first evidence of skeletal tuberculosis was observed on skeletal human remains from Neolithic sites found in Liguria (Formicola *et al.*, 1987; Canci *et al.*, 1996; Sparacello *et al.*, 2016; 2017), while the oldest probable skeletal evidence of leprosy date back to the 4th–3rd centuries BC and it was observed on a Celtic skeleton from the cemetery of Casalecchio Reno (Bologna) (Mariotti *et al.*, 2005). A case of tuberculosis was observed in a single female individual inhumed at the cemetery of Corvaro in the Central Apennines dated to the 7th–5th centuries BC (Rubini *et al.*, 2014). Minozzi *et al.* (2012) observed that there were little differences in the nature of the infectious diseases and other pathologies between suburban cemeteries (Osteria del Curato) and urban cemeteries (Collatina) in Rome. Higher percentages of individuals with infectious diseases like tuberculosis, endocranial lesions and metabolic diseases were found in the urban centre at Collatina, while higher percentage of individuals with periostitis and osteomyelitis, and pathologies related to work related activities, was mostly found at Osteria del Curato, the suburban site. According to the authors' view, these differences could have been related to differences in environmental and hygienic conditions between suburban and urban areas and social status. Along with the investigation of tuberculosis and leprosy, a few research focused on studying the presence of malaria during the Imperial Roman period in Central-Southern Italy (Isola Sacra, Portus Romae, Velia and Vagnari) (Marciniak *et al.,* 2016, 2018). Marciniak *et al.* (2018) utilised a multifaceted approach correlating genomic, epidemiology with archaeological evidence and historical record. This approach highlighted the importance of the relationship between the disease, ecology, and the human-environment interaction. One of the few evidence of brucellosis, a bacterial infection that spreads from animals to people mainly through unpasteurised dairy products, was observed in 16 individuals from Herculaneum (Capasso, 1999).

A wide range of bioarchaeological studies focused on investigating diet, health, and occupational activities across different temporal, social, or regional groups. Two comprehensive studies, which investigated diet and health conditions in an Etruscan population (6th-3rd centuries BC) from Spina, a cemetery located in north Italy, were published in the years 2013 and 2016 (Masotti *et al*., 2013; Manzon and Gualdi-Russo, 2016). Masotti *et al*. (2013) assessed the prevalence of dental features (e.g., caries, dental calculus, tooth wear, enamel hypoplasia, and abscesses) to evaluate the oral health and dietary habits of the Etruscan community. The authors found that this population had a good health status and suggested a mixed diet comprising also fish. The low observation of metabolic disorders corroborated the hypothesis of good nutrition. However, it should be noted that the suggestion of a diet comprising fish was made without the explicit support of chemical analysis such as stable isotopes analysis. Manzon and Gualdi-Russo's (2016) research focused, instead, on exploring the pathological conditions affecting the individuals buried at Spina and the prevalence rate between sexes and age classes. The data showed that the life expectancy was relatively high, and that the individuals had a good heath, confirming previous research. Sub-adults showed low rates of pathological lesions. Among adults, on the contrary, porotic hyperostosis, periostitis, osteoarthritis and Schmorl's nodes were more prevalent in adult males than in females. Females showed, instead, higher rates of cribra orbitalia, spinal osteoarthritis and tumour-bone lesions. As the porotic hyperostosis was widespread across the sample, Manzon and Gualdi-Russo (2016) hypothesised the possibility that some of the affected individuals suffered from a type of genetic anaemia, while others from an iron deficiency anaemia due to infections or nutrition. Regarding the presence of osteoarthritis, there was low frequency within the sample population overall, and the pattern suggests that men were more involved in heavier work activities.

A similar bioarchaeological study was undertaken to investigate health and occupational activities of the individuals buried in the Campovalano cemetery (Abruzzo). Cesana (2016) observed that the population from Campovalano (11th–2nd centuries BC) had a relatively good health, with low dental pathologies and low metabolic and infectious diseases. Most pathological lesions involved the vertebral column, with a low record of violent trauma present. Previous research was undertaken on this population which involved a study on mortality rate (Coppa and Colarossi, 1987), and an analysis of dental metrics coupled with dental and skeletal pathologies to understand genetic variabilities, health status, and the diet of the community (Capasso, 1987). Slightly different results compared to the one of Campovalano were obtained from a biocultural study conducted on a small Samnite population (6th-4th centuries BC) from Molise, in Central-South Italy (Petrone, 1994). Overall, the individuals presented a poor dental health with higher frequencies of dental lesions in females compared to males, suggesting a different diet between the sexes. Moreover, differences in subsistence activities between sexes was observed on the basis of the higher incidence of degenerative joint diseases and trauma found in males.

Several studies investigating the relationship between the social stratification and biological changes in the populations settled in Central-Southern Italy were conducted in recent years (Paine *et al.*, 2007; Sparacello, 2013; Sparacello *et al.*, 2014; Tanga *et al.*, 2016; Gentile *et al.*, 2018). Sparacello *et al.* (2017) also explored variations in stature and sexual dimorphism in relation to social status, in the Samnites population of Central Italy (800-27 BC). The authors found that there was a complex interrelation between social status and growth. Also research at Pontecagnano (province of Salerno) returned interesting results on this matter. Robb *et al*. (2001) utilised an approach which implied a multifactorial analysis of the individual's condition, linking information coming from the analysis of the skeletal remains with the one retrieved from the funerary treatments. By cross-tabulation statistical analysis between biological and social variables, the author demonstrated that the relationship between health, activity and social status is more complex than expected and such relationship cannot and be easily detected. In a later publication, Robb (2019) proposed to employ a life-course based approach to better understand the complexity of social patterns. One of the very latest work on the relations between social status, health and nutrition in Imperial Rome, utilising linear enamel hypoplasia (LEH) analysis, was the research conducted by Minozzi *et al.,* (2020). The authors found that social status played a major role in the differential distribution of enamel hypoplasia within two investigated cemeteries, Collatina and Casal Bertone. As expected, the frequency of affected teeth and individuals with LEH was different between the upper and lower social status. These lesions were higher in lower class individuals as a result of probably a different level of care given to lower class babies. However, in lower class individuals the frequencies of LEH decreased with the increase of age, while it remained constant in the upper class. This study showed that social status and formation of enamel hypoplasia are related, and that there were probably differences in the nutritional status of individuals within the same population.

An additional line of research focused on the theme of familiar segregation and population homogeneity in pre-Roman communities of Central-Southern Italy (Bondioli *et al.*, 1986; Rubini, 1996; Muzzall, 2015). Coppa *et al.* (1998) utilised discrete and metric dental traits to assess biological similarities and differences in 13 populations inhabiting both sides of the Apennine mountain in Central-Southern Italy (dated to the 1st millennium BC). Results showed that geography, with the presence of the mountainous environment, did not function as a barrier to the movement of people, leading to a more heterogeneous genetic group; rather, the sample seemed to cluster according to chronological periods. Rubini *et al.* (2007) utilised discrete cranial traits in order to validate Coppa *et al.* (1998) study. Differently from the research conducted by Coppa *et al.* (1998), in Rubini *et al.*'s (2007) work results showed evidence of a biological divergence between the Tyrrhenian and the Adriatic sides. The different outcome between the two studies was thought to be due to the fact that Coppa *et al.* (1998) also included skeletons from the Roman period, a time characterised by a great movement of people and cultural exchange (Rubini *et al*., 2007).

3.2.3 Novel Methodologies to the Study of Diet and Mobility

Gaps are still present in the knowledge of the foodways of pre-Roman communities in Italy. A few studies were carried out evaluating dental pathological lesions because of the information that they can give on diet, and even fewer archaeobotanical, zooarchaeological and isotopic studies were performed to widen the knowledge of what ancient community ate. A recent palaeodietary study of eight individuals form the cemetery at Gabii (6th–5th centuries BC), in Central Italy, was published by Acosta *et al*. (2019). The results of carbon and nitrogen isotopes showed that they had mainly a terrestrial C_3 diet; moreover the authors observed an increase in the consumption of millet, and food of higher trophic level during the transition from the Iron age to the Imperial period at Gabii. The authors argued that change in diet was linked with the urban development and changes in the local economy.

Many of the bioarchaeological studies in Italy concern the Classical world, and in particular the Imperial Rome. An extensive study was conducted by Tracy Prowse and colleagues on the Roman-age cemetery of Isola Sacra, on the Tyrrhenian coast near Rome, to understand diet and patterns of migration of the Roman population using isotope analyses. Prowse *et al*. (2004) evaluated the dietary history of sub-adults and adult individuals from Isola Sacra (on the coast) and from the inland site ANAS, analysing the $^{13}C/^{12}C$ and $^{15}N/^{14}N$ ratios of collagen and $^{13}C/^{12}C$ in carbonate of apatite. The comparison was utilised to assess if there were differences in diet between coastal and inland populations. Results showed, indeed, a different food intake between the sites. The isotopic composition from the individuals of the ANAS cemetery reflected a terrestrial-based diet, whilst the diet of the people form Isola Sacra was characterised by a mixed diet with a substantial component of marine foods, as well as terrestrial resources. A later research carried out on the individuals from Isola Sacra focused on the evaluation of correlations between age and sex and the isotopic composition of bone samples (Prowse *et al.,* 2005). The authors confirmed, with this new research, that the population of Isola Sacra had a mixed diet comprising both marine and terrestrial food. When sex was considered, the difference in dietary pattern between the sexes was little. Females, although, showed a less intake of marine food compared to males. Diet variation with age was visible, with sub-adults presenting isotopic values characteristics of a plant-based diet, whilst adults and old adults were probably introducing foodstuffs like olive oil and marine resources. An additional research study by Prowse *et al*., published in 2008, focused on isotope analysis of bone collagen to investigate feeding practices of children from Isola Sacra (1st to 3rd centuries AD) (Prowse *et al.,* 2008). Results from 37 rib samples showed that by 1 year of age the transitional feeding period began, and by 2-2.5 years of age the weaning period was completed. $\delta^{15}N$ and $\delta^{13}C$ values were in association with breastfeeding. In addition, the presence of caries and other dental pathologies in 78 individuals (age at death 1 to 12 years) suggested that complementary foods were given to individuals at early age, and this might have had an impact on their dental health.

Bondioli *et al.* (2016) combined stable isotope analysis with palaeodemography, stature, and pathological assessments to investigate diet and health of individuals buried in two Roman Imperial cemeteries, Isola Sacra and Velia-Porta Marina (Campania, 1st-2nd centuries AD). The authors found that these people ate a varied diet with consumption of marine food. Correlations were found between high stature, presence of skeletal disorders, work activities, and $\delta\ ^{15}N$ values, while there was no correlation between diet and physical stresses and cribra orbitalia. The intricate picture obtained from the analysis of these two cemeteries highlights the importance of considering multiple evidence to understand how much diet, health and occupational activities are linked during the individual's life course. Martyn *et al*. (2018) utilised stable isotope analysis paired with osteological information regarding age and sex of 81 individuals from Herculaneum. $\delta^{15}N$ and $\delta^{13}C$ values fall within the ranges of Isola Sacra and Velia and showed that the individuals of Herculaneum consumed primarily terrestrial food with a low intake of marine resources. As seen at Isola Sacra, males presented a greater isotopic enrichment compared to females, suggesting a greater access to marine food. Another recent study on Herculaneum is focused on understanding the reasons behind changes in dental microwear textures of permanent and deciduous teeth in the population of the site (Kelly *et al*., 2020). Results showed that diet has an impact in the formation of dental microwear during ageing, however the authors evaluated that other factors connected to the mandibular biomechanics may be involved in the formation of microwear textures in deciduous teeth of juvenile individuals.

Along with diet, migration and mobility of selected pre-Roman populations have been studied using isotope analysis. Strontium and oxygen isotope analyses were applied to investigate mobility of Bronze Age individuals inhabiting the Northern Italy. Cavazzuti *et al*. (2019b) were interested in exploring whether Bronze Age societies in the Po plain were keen to accept and integrate nonlocal individuals, and whether there was an import of raw materials and contacts with continental Europe and/or the Mediterranean. Results, which were integrated with osteological and archaeological data, showed that people moved mostly within 50 km radius, however, data from one settlement suggest that several individuals were coming from a more distant place. According to the authors, these results suggest that the formation of a more complex socio-political system in this area of Italy was generated as a result of a process which was internal to the community, and not as a consequence of external factors. A further research into the understanding of the importance that migrants had in the foundation of Frattesina (province of Rovigo), in the Po plain, was conducted by Cavazzuti *et al*. (2019b). Similarly to the previous study, the authors used strontium isotope analysis to study 46 individuals, and the sample was selected on the basis of their funerary contexts, such as where the individual was buried, sex, age and typology of grave goods. Evidence showed that migration to Frattesina was significant and elite individuals, identified by the burial record, were the most inclined to migrate.

Age-related immigration was investigated in the skeletal remains dated between the 1st and the 3rd century BC, from Isola Sacra and Portus Romae (Prowse *et al*., 2007). The authors found that during the Imperial period there was a large rate turnover and $\delta^{18}O_{ap}$ (which describes oxygen stable isotope of bone apatite) values showed that the migration, at least for a group of individuals, occurred before the third molar crown had completely formed (at 12-14 years). Through this study, the authors highlighted that migration was not selective to adult male individuals, but it involved families in a more complex phenomenon. Patterns of migration during the Imperial period in Rome were investigated at the cemeteries of Casal Bertone and Castellaccio Europarco (Killgrove and Montgomery, 2016). Strontium isotope analysis was performed on 105 individuals from Casal Bertone and Castellaccio Europarco, while oxygen analysis was carried out on 55 individuals. From the analysis of these data, the authors identified a number of outliers who were nonlocal to Rome, showing oxygen isotope values compatible with those of the Apennine and North Africa. Moreover, based on the analysis of carbon isotope on teeth and bones, they found that men and children migrated and that their diet changed over time.

3.2.4 The Research Gap

Considering the current state of the art in the field of bioarchaeological and biocultural research, it appears that most studies attempted to answer questions related to diet, health, mobility, and identity by coupling two or more methodologies that rely on either statistical analysis or qualitative observations. Robb (2019) proposed an exploratory methodology to evaluate an individual's life experience utilising a more advanced approach to the osteobiographical one. He focused on 47 adult individuals from Pontecagnano (5th-3rd centuries BC) and considered each individual as if it was related to another, during specific stages of the individual's life (birth, childhood, adult life, death). He therefore interrelated osteobiographies and he used presence or absence of grave goods to draw the stories of the people inhumed at Pontecagnano. Robb stressed that a more complex and non-deterministic path of lives may be observed in ancient communities when using this approach.

The methodology and approach employed in this thesis relates with the concerns expressed by Robb and to the standard osteobiographical study. However, it differs as this work incorporates novel methodologies of analysis (such as dental microwear texture analysis, and isotope analysis) with traditional bioarchaeological methods. In addition, the relationship between individuals and their specific burial treatment is investigated in depth, as well as the expression of gender and gendered behaviours, while reducing the reliance on statistical analysis.

The complexity of the natural and human world derives from several factors, some of which can be measured and some of which cannot, hence there is a need to develop methodologies that are able to bridge the measurable and non-measurable factors to gain a deeper understanding of complex processes. Interdisciplinary methodologies should aim to close this gap, and this research is an attempt to fill the gap in our understanding of past societies.

3.3 Reference Cemeteries

Five cemeteries, among those so far studied in Central-South Italy, are particularly relevant for this study: Satricum, Pontecagnano, Campovalano, Bazzano, and Alfedena Campo Consolino. The following section provides an insight into the studies conducted on the cemeteries selected as hot spots and the reasons why those cemeteries were selected. Moreover, the limitations and divergences of context to be considered during the comparison with the cemeteries object of this thesis is presented.

3.3.1 Satricum

Satricum represented one of the better excavated archaeological sites of Lazio, located 60 km southeast of Rome and 10 km from the coast (Gnade, 1992, 2002; Sengeløv *et al.*, 2020). Four cemeteries were excavated at Satricum in the past 30 years, all situated in different areas near the town of Satricum (northwest, acropolis, southwest, and Poggio dei Cavallari). The cemetery to the northwest of the town, dated to the 8th–7th centuries BC, and the distribution of the few excavated burials, was similar to the ones at Campovalano and other Iron Age cemeteries in Abruzzo, with a central tumulus surrounded by burials organised around it (Gnade, 2007). The southwest cemetery was the largest of the four, with more than 200 inhumation burials identified and 163 excavated (Sengeløv *et al.*, 2020). This cemetery dated to the 5th century BC and was discovered and excavated in the 1980s. The burials were organised following a different pattern (Figure 3.5): intersecting burials allocated forming small groups, alternatively in pair of two inhumations, or multiple inhumations (Gnade, 1992, 2002). The *fossae* were of different typologies: rectangular with ledges cut halfway along the long side of the burials, or with rectangular pits in a corner of the burials floor, or with a niche cut on the long wall (Gnade, 2002). The skeletons were positioned supine with the arms crossed over the pelvis or besides their body and buried with grave goods. The restricted number of combat-related objects recovered suggested that weapons had a symbolic value rather than an active one (Gnade, 1992, 2002). Of interest were the immatures burials (18% of the total number of burials), which were found alongside the ones of adults, comprising of a consistent number of ornamental items and, occasionally, miniaturised objects (Gnade, 1992, 2002).

Figure 3.5 The southwest cemetery at Satricum. Distributions of the burials. Modified after Gnade, 1992.

The age estimation of skeletal remains was carried out by Hoogland (1992) who analysed 94 skeletons over a total of 167 graves, assessing the age of 64 skeletons. Results showed that there was a scarce infantile mortality and that the majority of individuals died before reaching 25 years of age. Rubini *et al.* (2002) investigated the possible existence of a bio-anthropological divergence between the population of Satricum and the others of Central Italy using palaeodemographical and palaeonutritional analyses. Bioarchaeological studies have been applied to test hypothesis formulated in the past regarding the ethnological and cultural identity of Latin community of Post-Archaic Satricum (Sengeløv *et al.*, 2020). Previous studies on the material culture retrieved at Satricum suggested that the inhumation practice adopted by this population was similar to the one observed in Volscian cemeteries (Gnade, 1992, 2002). Strontium and oxygen isotope analyses revealed that all the individuals presented isotope values compatible with the isotope local range, indicating that they were locals. However, when the entire group of cemeteries were considered as a whole, the strontium concentration showed differences between the cemeteries, thus suggesting some level of variability. Similarly, morphological dental traits analysis showed that two different gene pools were present in the cemeteries, indicating that there was a change between the 5th and the 4th centuries BC burials. The authors, however, indicated that future research is still necessary to understand the origin of the community of Satricum.

3.3.2 Pontecagnano

The archaeological site of Pontecagnano is one of the largest cemeteries excavated in Campania. The site developed on a plain near the Picentino river, 10 km south of Salerno, it is surrounded by the Monti Picentini and situated about 5 km from the Tyrrhenian Sea (Cuozzo and Pellegrino, 2015). Over 6000 burials were excavated and dated between the 9th and the 4th centuries BC (d'Agostino, 1974). The burial site was organised in clusters. The main clusters of cemeteries developed around the settlement: one was located in S. Antonio at Picenza, in the east, and the other was in the west, near the Picentino river. Recent excavations identified a new cemetery located south of the settlement, dated from approximately the end of 7th century BC and the beginning of the 6th century BC to the 5th century BC (Pellegrino, 2004). Archaeological evidence showed interesting dynamics regarding the planning of the cemeteries and the use of the sites. It was observed that the cemeteries of the Early Iron Age ceased to be used during the Orientalising period when new burial areas developed adjacent to the old cemeteries (Bonaudo *et al.,* 2009). Inhumation in *fossa* burial was the main ritual practice adopted in the Orientalising period (end of 8th century BC) at Pontecagnano, although cremation was also observed (Cuozzo and Pellegrino, 2015). The funerary areas at Pontecagnano were organised according to specific rules; the tumuli were surrounded by dedicated cultic places or by distinct nuclei of burials placed within a complex system of enclosures made of travertine slabs (Bonaudo *et al.,* 2009). At the cemetery of INA CASA, a burial cluster located in the eastern sector of the settlement and dated between the 7th and the 5th centuries BC, immature individuals were buried within these enclosed structures (Figure 3.6) (Cuozzo, 1998; Bonaudo *et al.,* 2009). The presence of these structures was interpreted as a model to monumentalise the space for selective young individuals (Bonaudo *et al.*, 2009).

Figure 3.6 The layout of the cemetery at INA CASA, Pontecagnano. In evidence, coloured in dark grey, the presence of the enclosures. Modified after Pellegrino (2004).

The demographic profile for the individuals inhumed in the burials from the end of the 8th century BC and the first half of the 7th century BC at INA CASA was 42% adults and 58% infants (Cuozzo, 1994). Archaeological evidence showed that the system of enclosures was similarly used as a dedicated area for cultic activity, such as libation and votive offerings. The cemeteries developed to the west of the settlement showed similar structures of enclosures seen in the eastern areas, however, those structures seemed to vary in number and morphological and functional aspects. Some of the fences were built to demarcate areas dedicated to cultic activities, others were built for specific depositions and used for generations, as seen in the excavations of the properties at Erra III, Sabbato I, Granozio III and De Santis I (Bonaudo *et al.*, 2009). The funerary clusters developed south of the settlement and extended for about 400 meters. This area was occupied in different periods maintaining the articulation of the area in separate clusters divided by empty spaces.

The burials of the 6th and 5th centuries BC (e.g., at property Baldi) occupied a larger space, and were organised on isolated and distinct clusters divided by ditches and channels (Pellegrino, 2004). At property Baldi the number of burials excavated were 70, among which seven were cremations while the rest were inhumations. The individuals were inhumed supine in *fossa* burials within cists or coffins, however 16 infants were inhumed into an *olla* (Pellegrino, 2004). The system of enclosures was also visible in this cemetery and the number of grave goods varied between the enclosed inhumations and the burials retrieved just outside the enclosure. The inhumations of the 5th century BC were organised in lines occupying the empty spaces; occasionally it was observed that the burials were intersecting or overlapping, but without damaging the earlier inhumation (Pellegrino, 2004). The cemetery of Pontecagnano has been widely studied, yet only a section of the findings has been published to date. The publications focussed mainly on the burials of the early Iron Age and the period between the 4th and 3rd century BC (Serritella, 1995; De Natale, 2016). The information concerning other phases of occupation of the cemetery is, however, limited (Cuozzo, 1994, 2003). Many of the skeletal remains retrieved at Pontecagnano over the last 50 years were subjected to anthropological studies, with particular focus on demography, analysis of metrical and morphological dental traits, diet, palaeopathology, trauma, muscle markers (Fornaciari *et al.*, 1985; Mallegni *et al.*, 1985; Lombardi Pardini *et al.*, 1992; Becker, 1993; Robb, 1997, 1998; Sonego and Scarsini, 1994; Robb *et al.*, 2001; Scarabino *et al.*, 2006). A comprehensive description of the most relevant bioarchaeological studies on Pontecagnano is presented hereafter.

Studies on palaeodemography showed that there was a high mortality among individuals under the age of five. The adult average age at death was c. 30-40 years for males, while was lower, c. 25-30 years, for females. Research on dental pathologies conducted on 137 individuals dated 7th-4th centuries BC showed that males had a poorer dental heath than females, with a higher degree of severity (Fornaciari *et al.*, 1985). In addition, Fornaciari *et al.* (1985) compared two groups of individuals from different periods and observed that differences in dental pathologies existed between the two groups. The first group belonged to the 7th-6th centuries BC (Etruscan period), while the second belonged to the 5th-4th centuries BC (Oscan period). Results showed that both dental wear and periodontal diseases (PD) were higher in the individuals pertaining to the 7th–6th centuries BC, suggesting a change in diet in the Oscan period (Fornaciari *et* *al.*, 1985). The increasing of advanced state of worn teeth was visible from the third decade and males were more affected than females. Similarly male individuals exhibited greater degree of periodontal disease compared to females. The presence of high frequency of PD in mandibular teeth was explained by the authors as the result of inflammatory response of the gums to the stagnation of food within lower teeth. This phenomenon was linked with the high frequency of caries in mandibular teeth. In fact, 8.6% of the total teeth showed carious lesions, however not statistically significant difference was observed between the two groups of individuals from the different periods and between sexes. Fornaciari *et al.* (1985) noted, in addition, that females were more likely to show caries in the range of 25-30 years of age, while males later 30-45 years. The presence of caries in female individuals at early age could be correlated with the frequency of pregnancies and breast feedings. It has been suggested that the hormonal changes in women determine variations in the pH of the saliva resulting in producing a more cariogenic oral environment (Lukacs and Largaespada, 2006; Lukacs, 2008, 2011). Male individuals were slightly more affected by abscesses and antemortem tooth loss but the difference between sexes was not statistically significant, as well as between groups. When enamel hypoplasia was considered, individuals of the 7th-6th centuries BC period were more affected by it compared to those of the 5th-4th centuries BC. This may suggest that children of the earlier period were more affected by stress conditions that the children of the recent period. Dental and skeletal pathologies, as well as generalised stress indicators during the 7th-5th centuries BC at Pontecagnano were investigated a few years later by Sonego and Scarsini (1994).

To shed light on the dietary habits of the population inhabiting the sites at Pontecagnano (S. Antonio and Library), Scarabino *et al.* (2006) utilised Atomic Absorption Spectrometry and Isotope Ratio Mass Spectrometry. A total of 44 burials dated 8th and 3rd centuries BC were selected. The results from the stable isotope analysis ($\delta^{13}C$ and $\delta^{15}N$) indicated that the diet of the individuals was vegetable-based, with the ingestion of C_3 plants and a possible intake of herbivore animals. No statistically significance difference was observed between the two sites, which exhibited similar signals for both carbon and nitrogen.

Activity-related lesions on bones, trauma, and relationship between skeletal pathologies and social status were also investigated. Statistical analysis was used by Robb (1998), who analysed alteration of muscle marking formed by repetitive activities. He focused on general pattern of muscle marking variability within a skeletal sample. A total of 58 adult individuals of different periods (12 skeletons of the 7th–5th centuries BC, 42 skeletons of the 4th–3rd centuries BC, and 2 skeletons without chronology) were analysed and 18 muscle insertions sites (11 on arm and hand, and 7 on lower limb) were selected for the observations. Results showed that differences between sexes on the structure of muscle marking were visible, and they were explained as consequence of sexual dimorphism present in humans and sexual division of labour. If the muscle marking variation within each skeleton is considered, males showed greater variation than females. This variation was expressed in the upper limbs only, suggesting that males may have participated to a more varied range of habitual activities. In addition, the marked difference between sexes in the upper arm may indicate a social division of labour in which males of Pontecagnano performed heavier and more specialised tasks than females (Robb, 1998). When the presence of muscle marking was analysed against the age, the results showed that muscle marking increased with age, showing a progressive accumulation once the bone has finished its growth.

Robb (1998) carried out a cross-analysis of muscle score and grave goods to understand to what extend activity coincided with social status at Pontecagnano. Statistics revealed no simple relationship between muscle marking and the nature of the grave goods. When period and sexes were analysed separately, the relationship between muscle data and grave goods seemed clearer. In the 16 males from the 5th–3rd centuries BC, the cluster analysis exhibited differences in activities and health conditions and grave goods between high-status and low-status groups. In another publication dedicated to violence and gender, Robb (1997) investigated activities from a different perspective. The author analysed 56 adults from Pontecagnano belonging mainly to the 7th-5th centuries BC and the 5th-3rd centuries BC. Five individuals among the 56 studied showed healed crania trauma as well as post cranial fractures. Males were more affected by all different typologies of traumas than females, and Robb (1997) argued that the typology of lesions was not associated with violent attack, but rather due to work activities and falls.

Even though previous studies on palaeogemography, palaeopathology and diet of the skeletons from Pontecagnano were performed, none of these studies was conducted by considering the archaeological context. The study carried out by Robb *et al.* in 2001, was a pioneering one in this respect, in the sense that he systematically analysed the relationship between skeletal data and grave goods (Robb *et al.*, 2001). The author selected a sample of 94 adult individuals belonging to the 5th-3rd centuries BC. Sex and age were estimated, and data on stature, enamel hypoplasia, cribra orbitalia, trauma, tibial periostitis, and Schmorl's nodes were collected. Along with the information on the skeletons, selective aspects of the assemblages were considered. The cross-tabulation statistical analysis between biological and social variables showed that the relationship between health, activity and social status cannot be easily detected by the use of quantitative analysis. The data obtained in this study suggested that the differences in the burial rituals among the skeletal sample did not reflect differences in the skeletal heath. In addition, also in this case, it was noted that males had a more complex pattern of health than females probably as a consequence of males performing a more varied range of tasks than females. Robb *et al.* (2001), in this article stressed the importance of contextualising skeletal data with archaeological and historical ones, as certain skeletal responses may be considered socially significant in specific natural and cultural environments. Despite their merits, the studies of Pontecagnano still lacked in a broader analysis of the cemetery and in a comparison between osteological and dental data. In addition, the information retrieved from the analysis of the archaeological context was still missing. Robb (2019) explored a novel perspective to deepen the understanding of an individual's life experience by bridging skeletal and archaeological data.

3.3.3 Campovalano

The cemetery of Campovalano – Campli, which consists of 605 burials, is located 10 km north of Teramo, 450 meters asl, between Montagna di Campania, Montagna dei Fiore and the Adriatic coast (Chiaramonte Treré, 2003). The cemetery presented the same structure already described for Fossa, with a long continuity of use from the 12th to the

2nd centuries BC. Here, the monumental tumuli were used from the 12th to the 6th centuries BC. There were a few burials dated to the first and second phase of the Iron Age, whilst the larger number of inhumations (*c.* 270 in number) belonged to the 7th-5th centuries BC, which were distributed in an area of six kilometres (Chiaramonte Treré, 2003). The archaic burials were of *fossa* type enclosed around circles of stones (*tombe a circolo*) and dug in into the clay and gravel soils. The dimension of the *fossa* burials varied according to the stature and age of the deceased and the typology and number of the grave goods. The individuals were buried supine, and the burials were filled up with soil and stone, or occasionally, with a wooden cover, or exclusively with flat stones. On the contrary, the burials of children were covered with a large stone slab (Chiaramonte Treré, 2003). As seen at Fossa, there were cases in which burials overlapped. The analysis of the planimetry of the burials of the Orientalising-Archaic phase, where the burials tended to overlap, led to hypothesise a necessity to enhance the kinship between the deceased individuals and the hierarchy within the community (Acconcia and Ferrari, 2015). Even though a limited number of burials belonged to the 6th -5th centuries BC, some considerations regarding the grave goods and status of the individuals were observed (Acconcia, 2014). The degree of complexity of the grave goods varied between groups of burials, suggesting the presence of a differentiation in roles within the society (Acconcia, 2014). Of interest were the items frequently associated with female individuals, such as spindle-whorls, reels, and spindles. At Campovalano, textile-related tools were found in burials of adults, juveniles, and immature individuals, as well as an adult male individual (Acconcia, 2014). It must be highlighted that, at the time of the analysis of the grave goods, biological sex was not always estimated, and sex was assumed exclusively on the basis of the grave goods found in the burials.

The burials of the Hellenistic phase (*c.* 200) were closely positioned and distributed on either side of a road probably built during the development of the cemetery (D'Ercole, 1996; Chiaramonte Treré, 2003; Acconcia and Ferrari, 2015). Martellone (2016) noted, unexpectedly, that female individuals were inhumed with a low number of ornamental objects, while was common the introduction of amphorae in the burial. A change in the funerary practice between neonates and children (aged between two years and seven years) was observed, with children occasionally buried with a small spearhead. The set of grave goods dedicated to males consisted generally of razors, strigils, spearheads, and ceramic vessels (Martellone, 2016).

Several analyses on the skeletal human remains were carried out in the past years. Demography showed a diachronic change between the Orientalising—Archaic and Hellenistic periods, with an increase of the life expectancy of adults and immatures in the later period (Cesana, 2016). A high prevalence of individuals younger than 20 years (36.7%) was observed in the group of burials dated to the Archaic period and, specifically, a high infant mortality was observed in groups of burials dated to Orientalising-Archaic and Italic-Hellenistic (Cesana, 2016). Pathological conditions affecting the spine were the main features observed, followed by dental pathologies, which were rarely present. This datum differs from previous studies where high level of dental pathologies were observed (Coppa *et al.*, 1998; Cucina *et al.*, 2000). No metabolic diseases, infectious diseases, or traumatic injuries connected with violent activities were recorded. Little diachronic differences were seen in the distribution and frequency of the pathological lesions. Cesana (2016) argued that the population from Campovalano was performing activities typical of a mountainous environment and that adult individuals were involved in activities which would have affected the axial skeleton such as carrying baskets over their head or works requiring a flexed back.

Research on familial segregation and kinship was carried out for the cemetery at Campovalano. Muzzall (2015) tested the hypothesis that the community living at Campovalano in the 750-100 BC was more phenotypically variable as a result of a broader idea of kinship compared to the community living at Alfedena. He found that it was not possible to see differences in the organisation of the cemetery according to biological kinship between Alfedena and Campovalano. However, he argued that a greater diversity in burial and social organisation was present in the Iron Age Central Italy than previously thought.

3.3.4 Bazzano

The cemetery of Bazzano, located in the Aterno River Valley 4 km north of the cemetery of Fossa, was systematically excavated in the years 1992-2006. The cemetery yielded a total of 1672 burials, among which 700 dated between the end of the first Iron

Age and the Orientalising and Archaic periods. To date, the cemetery of Bazzano is considered the largest site found in Abruzzo; occupying an area of 40.000 m^2 (Weidig, 2014). The cemetery was characterised by a long continuity of use, from the 8th century BC to the Roman Republican period. Weidig (2014), in his volume entirely dedicated to the cemetery of Bazzano, provided a detailed re-examination of all the funerary contexts of the cemetery belonging to the Iron Age period. The use of large tumuli was progressively replaced by the adoption of smaller tumuli and *fossa* burials from early 6^{th} century BC, while the chamber burials date back to the Hellenistic period (Benelli and Rizzitelli, 2010; Weidig, 2014). By examining the planimetry of the cemetery and the distribution of the burials, it was noted that the area was organised in sectors, and among those were large empty spaces (Figure 3.7). The space around earlier tumuli (dated from mid-8th century BC to the early 7th century BC) was re-occupied, in the Orientalising-Archaic periods, by groups of *fossa* burials following a specific and organised planning classified by scholars as within rectangles (*a rettangoli)* (D'Ercole and Martellone, 2008). In contrast to the cemetery of Campovalano, where multiple individuals were buried within the space of the tumulus, at Bazzano the tumuli were dedicated to single inhumations (Weidig, 2014).

Figure 3.7 Layout of the Bazzano cemetery. Distribution of the burials organised to form rectangles (a rettangoli). Modified after Acconcia and Ferrari (2015).

The burials from the 8th–5th centuries BC were all inhumations in *fossa* burials with individuals inhumed in supine position. The dimension of the *fossa* varied according to the stature of the deceased, however occasionally the burials were longer in dimension to allocate the niche or *ripostiglio* usually containing an *olla* or other vessels (Weidig, 2014). Weidig (2014) also reported that the *fossa* was covered using lithic slabs, or soil and stone, directly over the deceased or over wooden planks. The burials of infants were occasionally covered with one lithic slab. An accurate description of the objects found in the graves was provided by Weidig (2014), who noted a reduction of the grave goods in the burials of the later periods, as well as an unequal (in number) subdivision of male, female, and infant burials. Male and infant burials were more prevalent in number than female ones in the earlier phase (mid-8th century BC to the early 7th century BC); female and infant burials were more prevalent in the later period (late 7th– early 6th century BC) (Acconcia and Ferrari, 2015).

Most of the studies on this site entailed an in-depth analysis of typology and distribution of grave goods within the cemetery (Weidig, 2008), a description of the funerary rituals (Weidig, 2015), and the study of imports of objects of Picene culture (Weidig, 2007). Based on the analysis of the archaeological context, Weidig (2014) cautiously suggested that the burials were organised according to family units or to the social status of the individuals. The author noticed that infants were inhumed close to warrior burials (defined by the presence of weapons in the burials, at Bazzano a high number of burials with weapons were found), whereas female burials were found distant from the main groups. The role of war and warriors in the Aterno Valley during the archaic period was investigated by Scarsella (2019), which explored settlement patterns and archaeological evidence to define the role of aggressions within communities in the mountain landscapes. Scarsella (2019) concluded that intense competition for economic resources, lack of centralisation and a consequently large space left to individuality, were the principal elements for violence.

Palaeopathological and bioarchaeological studies on the skeletons of Bazzano are limited. A total of 338 skeletons from the Orientalising-Archaic and Hellenistic periods were included in a bioarchaeological study, which investigated changes in social stratification, warfare and habitually performed activities among Iron Age populations of Central Italy (Sparacello, 2013). Males' activity in the Samnites communities of Central-Southern Italy was investigated by Sparacello *et al*. (2014). Here, a bioarchaeological research framework was proposed, and skeletal properties (limbs asymmetry) were analysed in relation to funerary treatments. The aim of the research was to study warfare and understand aspects of military organisation in the Orientalising-Archaic and Hellenistic periods. Results showed that there was a correlation in the Orientalising-Archaic period between the extent of humeral asymmetry and the number of grave goods in the burials. Therefore, individuals with richest burials displayed also higher humeral asymmetry. This correlation was not visible in the Hellenistic period, where instead was true the opposite: individuals with fewer grave goods showed higher humeral asymmetry. The authors argued that the change in humeral asymmetry was related with a shift in military organisation and socio-political development historically described from the Orientalising-Archaic to the Hellenistic period. A further research which involved the Bazzano cemetery (225 burials) was published in 2017 (Sparacello *et al.,* 2017). In this work, Sparacello *et al.* (2017) evaluated whether there were diachronic changes during the period of social reorganisation, which has been considered as the period that goes from the Orientalising-Archaic (c.800–500 BC) to the Hellenistic (c.400–27 BC). Contrary to the expectations, it was not observed any significant diachronic change of stature or sexual dimorphism. The authors observed that the stature in males changed between high and low status, the former being taller than the latter, probably due to a better diet. However, this difference was not seen among the females, who might have developed better buffer mechanism against the environment, or they might have had differential access to food. This study, differently from the previously described ones conducted on similar populations, highlighted the complex interaction which is present between biological, social, and environmental factors.

3.3.5 Alfedena Campo Consolino

The cemetery at Alfedena Campo Consolino was located high in the Sangro Valley (900 meters asl), in the southern area of the Abruzzo region. The site was first excavated in the 18th century (Mariani, 1901) uncovering about 1500 burials over a surface of c. 36.000 m^2. Nevertheless, a significant portion of the skeletal material was lost or misplaced (Robert R Paine *et al.*, 2007). Additional excavations were conducted between 1974-1979, and identified a further 132 burials (Parise Badoni and Ruggeri Giove, 1980; Acconcia, 2014). The cemetery was active from the 7th to the 3rd centuries BC; its layout find parallels with the arrangement of burials at Opi Val Fondillo and at Bazzano, as well as some sites in Lazio such as Acqua Acetosa Laurentina (D'Ercole and Martellone, 2008; Acconcia and Ferrari, 2015). The cemetery was organised following two distinct patterns (Figure 3.8). In one area, the burials were positioned in circular patterns or concentric rings around an empty space, whilst in the other, belonging to the end of 6th and the 4th centuries BC, the burials were distributed to form a rectangle, as observed at Bazzano (Parise Badoni and Ruggeri Giove, 1980).

Figure 3.8 Layout of the cemetery at Alfedena Campo Consolino. Modified after Scopacasa (2015).

The funerary ritual of the 6th and 5th century BC consisted of placing the deceased in earthen trenches with limestone slabs delineating the perimeter of the trench cut forming a stone-lined cist which was covered with a large limestone slab or with wooden boards (Tagliamonte, 1996). The burials were then covered with soil and stone to make them visible from the ground (Acconcia and Ferrari, 2015). The deceased was placed supine and often wrapped in a shroud, as attested by the presence of fibulae used to fasten it and the remains of the fabric (Bispham, 2007; citing Faustoferri, 2003). These tombs often contained the *olla* enclosed by stones *ripostiglio* and placed at an intermediate level, over the limestone slabs (Tagliamonte, 1996). Burials at Alfedena Campo Consolino contained limited grave goods and the homogeneity of the objects was interpreted as the reflection of a conservative community with a rigorous ritual (Luttikhuizen, 2000; Acconcia, 2014). Scopacasa (2014a) utilised statistical methods, correlating between grave goods, sex, age, and social status, to evaluate the existence of differences in gendered behaviour and social activities between male and female individuals, within the community of Alfedena. According to his results, the expression of gender in burials was not clearly visible, and there was probably equality in the activities performed by men and women.

The spatial distribution of the burials into circular clusters led to the hypothesis that the funerary practice was based on kinship and family groups. Biodistance analysis conducted on the skeletons from Alfedena Campo Consolino showed that individuals with morphometric and morphological similarities were buried within each enclosure supporting the hypothesis that each circle was expression of family ties with a patrilocal biological lineage (Bondioli *et al.*, 1986; Rubini, 1996). Bondioli *et al*. (1986) analysed dental metric and non-metric traits from the individuals buried at the cemetery of Alfedena (500-400 BC) to investigate whether the organisation of the burials in separate structures was linked with the presence of kinship groups within the population. The authors observed that individuals buried in the groups of graves were sharing morphometric and morphological similarities and assumed that those individuals were kinship groups. Moreover, they observed that variance segregation was more evident in males suggesting that these groups could be patrilocal kin groups. A recent research on biodistance demonstrated that the biological kinship organisation at Alfedena Campo Consolino was not strongly visible from the analysed data (Muzzall, 2015). Palaeodemografic data showed that the individuals at Alfedena had relatively low mortality rate, with the highest number of individuals aged 50 years and older (Coppa and Colarossi, 1987; Rubini *et al.*, 2002). Evidence of increase in oral pathologies was observed at Alfedena from the 5th century BC (Macchiarelli and Salvadei, 1986). Numerous studies were undertaken to investigate patterns of activities among female and male individuals. Sparacello *et al*. (2011) compared cross-sectional geometrical properties of skeletal human remains from Alfedena (Iron Age period) with the ones of a Neolithic sample from Liguria (North Italy). They observed that lower limb robusticity decreased in both sexes in the Alfedena sample compared to the Neolithic sample, suggesting a more sedentary life. Moreover, male individuals from Alfedena displayed humeral bilateral asymmetry, which was described as a consequence of repetitive and more stressful unimanual activities and was less visible in the female individuals. The authors explained this outcome as the result of a society with gendered division of labour, in which males performed activities related to production and status (warriors), while females were involved in more sedentary and time-consuming tasks. The consideration that the individuals inhumed at Alfedena were involved in violent activity was also investigated by Paine *et al*. (2007). In the latter research, the authors observed that cranial injuries were more prevalent in males than females. In addition, the authors noted that the pattern of the injuries was random suggesting that they were the result of local conflict rather than of organised combat. These results, coupled with the archaeological evidence, led to the conclusion that the cranial injuries occurred while defending local communal agricultural resources.

3.3.6 Summary and Limitations

The five funerary sites described in the previous sub-sections of section 3.3, which were selected as reference sites, differ in terms of context and extent of studies when compared with the cemeteries at the centre of this thesis. When the former sites are compared with the latter sites, there are two main limitations that should be noted: the first is the different size of the cemeteries, and the second is the continuity of use. The cemeteries of Nocciano (3.1.2.2.3), Loreto Aprutino-Cappuccini (3.1.2.2.4), Moscufo (3.1.2.2.5), Spoltore (3.1.2.2.6), and Pescara (3.1.2.2.7) were all small cemeteries with a limited number of burials. Differently, the cemeteries of Satricum, Pontecagnano, Campovalano, Bazzano, and Alfedena had greater dimensions and comprised hundreds or thousands of burials. The limited sample size can hinder the investigation of the cemeteries and complicate the understanding of the setting. Because investigations are based on a small number of burials and of associated individuals, observations that involve one or two individuals may affect the results leading to biased conclusions. As a consequence, attention must be paid when interpreting the results, in particular if statistical analysis is involved. As far as the continuity of use is concerned, the period of use of the cemeteries subject of this thesis, that is 6th and the 4th centuries BC, differs from the one of the cemeteries included in the reference cemeteries. In fact, the latter sites were in use for several centuries, with some of those sites used from the Iron Age to the Hellenistic period. Social and cultural changes may have occurred in those centuries, even within the same site, hence they need to be considered when making parallels with sites characterised by continuity of use.

Chapter 4 The Cemeteries: Site Description and Burial Practice

4.1 Site Description

The cemeteries under investigation were part of an extensive archaeological excavation which took place in Abruzzo from the second half of the twentieth century until recently. Five sites have been selected for this study because they provide the best evidence for the understanding of general health and funerary rituals of the populations which inhabited the Abruzzo region. The sites are located within the Pescara District, in an area stretching from the Gran Sasso mountain chain to the Adriatic coast (Figure 4.1). These cemeteries were in use between the 6th–4th centuries BC based on datable artefacts. A brief description of each cemetery, based on the information extrapolated from published materials, is presented in the following subsections.

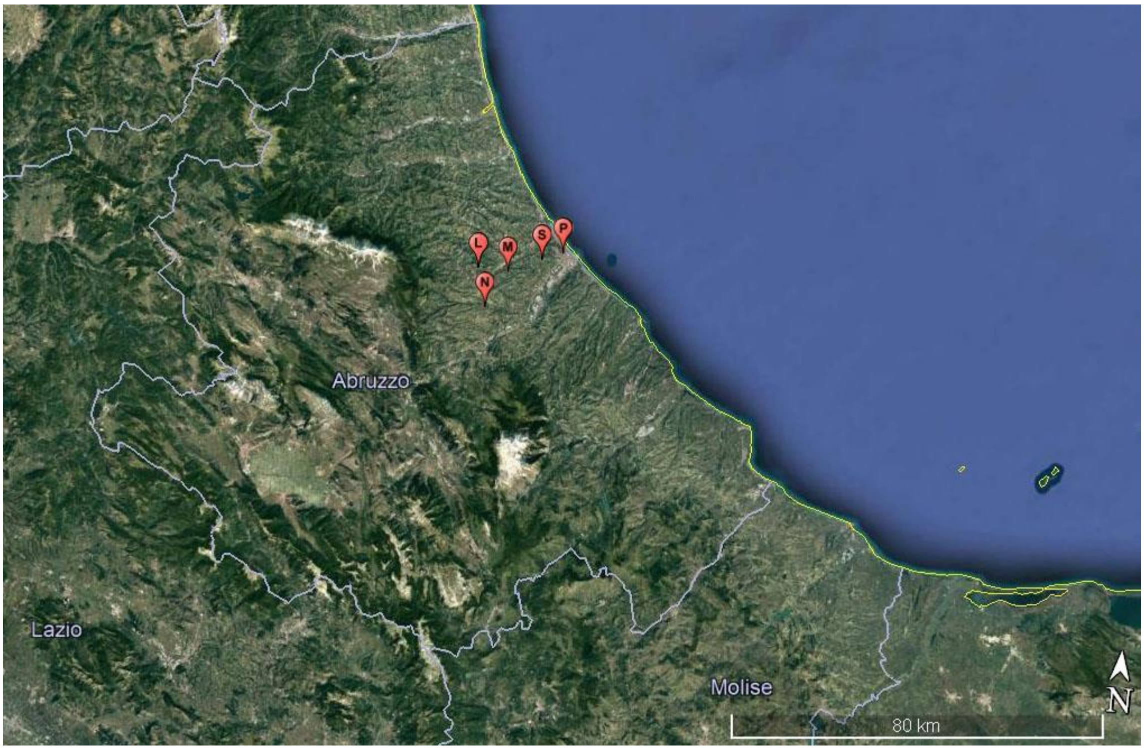

Figure 4.1 Locations of the cemeteries. From the hinterland to the coast: L=Loreto Aprutino-Cappuccini; N=Nocciano-Fonte Schiavo; M=Moscufo-Via Petrarca; S=Spoltore-Quagliera; P=Pescara-Campo sportivo Ex Gesuiti. Google earth image.

4.1.1 Loreto Aprutino-Cappuccini

The cemetery of Loreto Aprutino-Cappuccini (Loreto Ap.-Cappuccini) is located about 25 km west of the mouth of the Pescara river, at 230 m asl. This area has been under excavation since 1932, but only in the years between 1999 and 2009 was the main cemetery identified and properly excavated. The cemetery in the Cappuccini quarter consists of three scattered groups of burials: PEEP1, Corolongo, and PEEP2. Seven and six burials have been excavated in PEEP1 and Corolongo respectively, while 51 burials were excavated in PEEP2 (Figure 4.2), bringing the total number of burials to 64 (Di Tommaso, 2009; Staffa, 2003a, 2003b). Based on the diagnostic artefacts found in the cemetery, the burials dated to the 6th–4th centuries BC, however most of the burials appeared to be of the 5th century BC. All of the burials were supine inhumations in simple *fossae*, with or without niche (Staffa, 2003a, 2003b).

Figure 4.2 Layout of the Loreto Aprutino-Cappuccini cemetery-area PEEP2, with the location of the most recently investigated area (2009 excavation). The burials are indicated with 't' and the burial number. Modified after Staffa 2003a.

4.1.2 Moscufo-Via Petrarca

The cemetery at Moscufo–Borgo San Rocco, Via Petrarca was excavated in 2008. The cemetery is located about 20.2 km west of the mouth of the Pescara river at 220 m asl. A large section of the site was detected near the medieval town of Moscufo, and in this area 24 *fossa* burials were excavated. The burials were dated from the second half of the 6th century BC to the 5th century BC. All of the burials were supine inhumations in simple *fossae*, with or without niche (Staffa, 2010). Unfortunately, the limited published data available on this cemetery has hindered a detailed analysis of the site.

4.1.3 Spoltore-Quagliera

The cemetery of "Quagliera" is located 5 km north of the mouth of the river Pescara near the town of Spoltore. The excavation of the cemetery was conducted in two campaigns: the first one took place in 2009 and two burials dated to the 5th–4th centuries BC were excavated (Staffa and Cherstich, 2009); the second one occurred in 2013 and 34 burials were retrieved (Staffa and Cherstich, 2020). The burials were supine inhumations in simple *fossae*, with or without niche and organised mainly in parallel rows, with 30 of them oriented E-W and six oriented N-S. The analysis of the burials distributions and the grave goods is still incomplete (Staffa and Cherstich, 2020).

4.1.4 Pescara-Ex Gesuiti

The cemetery of Pescara-Ex Gesuiti is located about 3 km north-west of the mouth of the Pescara river at 43 m asl in a modern football field "Campo sportivo ex Gesuiti". The earliest recorded evidence for a cemetery was the discovery in the years 1938-1943 of several burials east of the Gesuiti church. However, it was not until 1997-98 that a major sector of the cemetery was explored (Staffa, 2001, 2003b). The excavation record mentioned that 11 burials dated from the 6th to the 4th centuries BC were excavated. (Staffa, 2001, 2003b). Most of the burials were badly damaged by agricultural work, in addition, the pH and consistency of the soil caused the loss of almost all the skeletal remains, thus compromising the understanding of the layout of the bodies. (Staffa, 2001, 2003b).

4.1.5 Nocciano

The cemetery of Nocciano is located 28 km west of the mouth of the Pescara river, at about 228 m asl. The first excavation of the cemetery was conducted between 1971 and 1973, and nine inhumation burials dated to the 6th–5th centuries BC were discovered (de Pompeis and Paolini, 1980). A different sector of the cemetery was excavated in the years between 1974 and 1981 with the revelation of three more burials. The present research focused on the excavation conducted between 1971 and 1973.

Chapter 5 Materials and Methods

The skeletal collections used in this study are overseen by the *Soprintendenza Archeologia Belle Arti e Paesaggio per le Provincie di Chieti e Pescara*. Permission to conduct an osteological examination of the skeletons was provided by this *Soprintendenza*. In addition, permission to transport and carry out destructive tests on the samples was provided by the *Soprintendenza Archeologia Belle Arti e Paesaggio per le Provincie di Chieti e Pescara* on behalf of the *Ministero per la Cultura* of Rome, in agreement with all relevant regulations concerning human remains from ancient Italy (available upon request).

5.1 Materials

The following sections will describe the number of skeletal remains per each cemetery and the availability of published data (5.1.1), the sample selection for the microwear (5.1.2), the isotope analyses (5.1.3) and the list of grave goods present divided by object type (5.1.4).

5.1.1 Cemeteries

The cemeteries were introduced and described in Chapter 4, along with the relevant information regarding their funerary context. It was decided to consider only the remains dating to the 6th–4th centuries BC of a defined area of Abruzzo, including as much information as possible regarding the skeletal materials and the grave goods, in order to have a detailed representation of the population's health and social aspects in a precise and confined location. The sample used in this study comprised skeletal remains and grave goods from five cemeteries (Table 5.1), located within the area of modern Pescara county in Abruzzo.

The five cemetery sites are: Loreto Aprutino-Cappuccini (N = 64 burials), Moscufo-Via Petrarca (N = 24 burials), Spoltore-Quagliera (N = 36 burials), Pescara-Ex Gesuiti (N = 11 burials), and Nocciano (N = 9 burials). All 144 burials included in the sample have been studied in their entirety, even burials without skeletons were used to enhance the understanding of the funerary contexts. Of the 144 burials, 92 contained skeletal materials available for the osteological study and grave objects: Loreto Aprutino–

Cappuccini (N = 38 skeletons), Moscufo – Via Petrarca (N = 23 skeletons) and Spoltore-Quagliera (N = 33 skeletons). Nocciano and Pescara provided information on grave goods only as the skeletal remains were in too poor state of preservation for analyses.

Table 5.1 List of the cemeteries included in the research.

Materials				
Site	**Number of Burials**	**Number of Skeletons**	**Period**	**Additional Information**
Loreto Aprutino-Cappuccini	64	38	6th-4th centuries BC	Burial dimensions of some tombs are missing
Moscufo-Via Petrarca	24	23	6th-4th centuries BC	Partial access to excavation reports; 3 skeletons lacked burial number; some skeletons had been commingled post excavation
Spoltore-Quagliera	36	31	6th-4th centuries BC	Complete burial and skeletal information available
Pescara-Campo sportive Ex Gesuiti	11	0	6th-4th centuries BC	Poor bone preservation, no skeletal remains available
Nocciano	9	0	6th-4th centuries BC	No skeletal remains available
Total sample size	**144**	**92**	**6th-4th centuries BC**	-

The grave goods were not available for direct study rather the analyses of the funerary contexts and grave goods was based on published (de Pompeis and Paolini, 1980; Staffa, 1998, 2003a, 2003b; Di Tommaso, 2009; Staffa and Cherstich, 2009) and unpublished information (Staffa and Cherstich, 2020). The published documentation on the Nocciano (de Pompeis and Paolini, 1980) and Pescara cemeteries (Staffa, 2001) was very detailed and proved to be useful in the funerary context reconstruction phase. The documentation available for Loreto Aprutino-Cappuccini and Spoltore-Quagliera were detailed and useful (Staffa, 2003a, 2003b, 1998; Staffa and Cherstich, 2020), while the funerary context data available from the Moscufo – Via Petrarca cemetery were limited (Staffa, 2010).

5.1.2 Materials for Microwear Texture Analysis

Microwear surface texture analysis was executed on 54 skeletons from the three sites of Loreto Aprutino–Cappuccini (N = 23), Moscufo–Via Petrarca (N = 10), and Spoltore-Quagliera (N = 21) cemeteries. Well preserved second molars in full occlusion and showing wear facet 9 (crushing and grinding facet) were considered for this project in agreement with relevant publications in the field (Schmidt *et al.,* 2015). Molars were preferred to investigate diet, as the anterior teeth may be used for extra masticatory activities not related to diet. For three skeletons the second molar was substituted with a first molar due to the absence of suitable M2. Age and sex of the selected individuals were assessed following osteological standard procedures (Age: Miles, 1963; Ubelaker, 1989; Brooks and Suchey, 1990; Schaefer *et al.*, 2009. Sex: Acsádi and Nemeskéri, 1970; Buikstra and Ubelaker, 1994; Brickley and McKinley, 2004).

5.1.3 Materials for Isotope Analyses

The Loreto Aprutino – Cappuccini cemetery was the only site investigated using isotopic analyses with the aim to create a more comprehensive dataset. The reason to focus on Loreto Aprutino cemetery is that it comprised the largest number of skeletal remains, of which the dental remains were well preserved, and detailed descriptions were available regarding the funerary context and grave goods.

Intact permanent M2 from 16 individuals (N = 5 juveniles (12-20 years), N = 6 young adults (20-35 years), and N = 5 adults (35-50+)) were selected for enamel and dentine sampling. The second molar was selected because the crown is formed after a child is weaned and so will not provide mixed isotope signals, coming from both the mother and the child, as result of breastfeeding (Petersone-Gordina *et al.,* 2019). Five grams of dentine were sampled for carbon (C) and nitrogen (N) isotopes analyses, 4 g of enamel for strontium (Sr) analyses. As a control animal bones (n=2) recovered in the skeletal boxes from Loreto Aprutino – Cappuccini and Moscufo - Via Petrarca cemeteries, were processed for carbon and nitrogen isotope analysis. Since perishable vegetative materials do not survive within burial contexts a leaf sample recovered from the area of the Loreto Aprutino–Cappuccini cemetery, was processed to record the local strontium isotope signals.

5.1.4 Funerary Evidence – Grave Goods

Funerary evidence was considered integral material to the present study because it is very useful to evaluate relationships between biological and social variables. For this reason, an examination of published reports on the cemeteries located between the hinterland and the lower Pescara valley (Staffa, 2003a, 2003b) was undertaken and a dataset of grave goods and grave descriptions was created. Table 5.2 displays the list of objects considered in this project. The object description comprises three defining characteristics of each object: general description of its shape, the material used and its function.

Table 5.2 List of objects considered in this project presented in alphabetical order.

Object	Description
Amphora	Closed shape, globular or ovoid body, cylindrical neck, wide mouth and rim cut, rounded rim, double vertical handles, concave or ring base. Material: ceramic bucchero or fine-ware. Function: liquid storage container.
Armilla	Metallic object, plain or decorated surface, single ring or spiral. Material: bronze. Function: jewellery/ornamental.
Beads and pendants	Beads and pendants plain or decorated, various shapes and dimensions linked to fibulae, necklaces and bracelets. Material: amber, coral, glass, glass paste, bone, ivory, Cypreae shell, Phoenician glass faces beads. Function: jewellery/ornamental.
Belt	Strip of metallic foil, two hook clasps fixed with nails (plain or decorated), pairs of eyelets for hook insertion, series of small holes along the edge (to connect rivets with the organic fabric/leather). Material: bronze. Function: supporting clothing at waist.
Reel	Small tool, cylindrical part at the centre and cone shape upper ends. Material: terracotta. Function: to wind or hook yarn.
Bronze bowl, cauldron	Open shape, large or medium size rounded and globular body, short walls, cut rim, with or without iron handle. Material: bronze. Function: liquid container.
Bronze rings 'cape'	Series of orderly aligned small bronze rings, occasionally with disks with small hole in the middle. Material: bronze, bone, ivory (for disks). Function: ornamental, probably sewn on a cloth.
Cup	Open shape, hemispherical, truncated-conical or carinated body, rounded and everted rim, flat base, single or double horizontal handle. Material: impasto or fine-ware. Function: drinking vessel.
Diadem	Ornamental headband. Material: bronze, bone, glass. Function: ornamental.
Dipper (usually into *olla* or *dolium*)	Open shape slightly carinated or hemispherical small cup with one long vertical handle. Material: fine-ware or impasto bucchero. Function: ladling and pouring liquids.
Dolium	Large globular vessel with thick rim. Material: impasto or occasionally in coarse-ware. Function: liquid storage vessel.
Fibula	Consisting of a body, a pin and a catch; simple, undulating, swollen, decorated flat arch, *Certosa* type; plain or decorated arch; with or without pendants. Material: bronze, iron, for pendants (glass, bone, glass paste, amber, bronze). Function: fastening garments, ornamental.
Jug	Close shape, globular or ovoid body, cylindrical neck, rim cut, mouth with everted and round lip or with projecting pouring lip, flat or ring base.

Object	Description
Kantharos	Open shape, globular body pedestal base, flared rim and two lateral horizontal strap handles, plain or with concentric bands and drops-pattern decoration Daunian "mixed style" (T30 Spoltore). Material: impasto bucchero or buff ware. Function: drinking cup.
***Kardiophylax* (chest armour)**	Disk shape, two plain plaques linked by an iron and organic band, or trefoil cuirass executed with three disks (one at the bottom) in relief. Material: bronze, iron, leather. Function: chest armour.
Knife/dagger	1) Straight and thin blade (ca 24–36 cm long) single edged, bone handle. 2) Straight and thick blade (ca 24–36 cm long) double edged, wide tongue-tang. 3) Straight and thick blade (ca 24–36 cm long) single edged, thin rounded tang. Material: iron, bone, wood. Function: food preparation, weapon.
Krater (only the base present)	Open shape, large broad body, wide mouth, wide and round base, decorated (T1 Spoltore, red paint decoration Daunian “mixed style”). Material: ceramic, fine-ware. Function: vessel for diluting wine with water.
Necklace	Degradable material or occasionally small bronze chain used as wire, beads and pendants of different shape form the decoration of the necklaces. Material: bronze, glass, glass paste, coral, amber, ivory, bone. Function: ornamental.
Oinochoe	Close shape, globular body, trefoil mouth, single long vertical handle. Attic black figure (owl standing on a pedestal) in T9 Spoltore grave, or plain. Material: ceramic, bucchero. Function: wine container.
Olla	Ovoid or globular shape vessel with everted rim, occasionally decorated with appliques or geometric patterns. Material: ceramic coarse-ware or fine-ware. Function: food and liquid container.
Olpe	Closed shape, ovoid body, narrow neck, rim cut, flat base and single long vertical handle. Material: ceramic, impasto bucchero. Function: containing and pouring liquids.
Razor	Small tool, thin semi-lunate, curved blade, hook on the top extremity. Material: iron. Function: removing facial or body hair.
Skyphos	Open shape, deep cup with double horizontal handles attached near the rim, wide base, figurative composition with palmettes or plain. Material: ceramic, black-glazed ware or red impasto. Function: wine-cup.
Shoes soles + crampons	Remain of a sole with an attached series of iron spikes. Material: wood, iron. Function: traversing snow and ice.
Spearhead	Elongated blade, leaf-shape, thin head, or long shank and small ending blade. Material: iron. Function: throwing weapon.
Spindle-whorl	Perforated weight from wooden spindle, truncated-cone, star or pear shape. Material: fine-ware, coarse-ware, terracotta, metal (lead?). Function: spinning fibres into yarn.
Spit/skewer	Long thin metal stick, occasionally small loop on one extremity. Material: iron. Function: grilling and roasting food
Strainer	Open shape, bowl-shape small size with wide mouth and short walls, punched holes on the lower surface, sinuous wire handle. Material: bronze. Function: wine-strainer.
Sword	Long double cutting edges blade (ca 75-80 cm) with cross guarded handle or short and very curved blade with single cutting edge. Material: iron. Function: attack weapon.
Torque	Large stiff neck ring in metal, plain or decorated surface. Material: bronze. Function: ornamental.
Vessel	Open shape, wide mouth, single or double horizontal handles, with or without pourers, high or short foot, plain or decorated. Material: fine ware, coarse ware, impasto bucchero, buff ware. Function: liquid or food container.

5.2 Methods

The section below contains the methodology applied to answer the research questions proposed in Chapter 1. Skeletal analyses of the entire sample were undertaken following the standards established by Buikstra and Ubelaker (1994), Brickley and McKinley (2004), and Steckel *et al.,* (2006). Published excavation reports on the five cemeteries were examined to obtain data on the funerary contexts, and detailed tables were built to summarise the information.

5.2.1 Skeletal Remains Assessment Procedures

The skeletal collection, comprising the cemeteries of Loreto Aprutino–Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera, was examined during this study for the first time since excavation. Since the skeletons were still covered with soil the first step was to clean them. The best procedure to clean human bones without damaging their surface and taking into account their high degree of erosion was selected. Bone and teeth were cleaned using soft bristle toothbrushes, Q-tips, sticks and occasionally water. The soil was sieved to collect small fragments of bones and other possible non-bone materials missed during the macroscopic cleaning. Finally, all the skeletal elements were wrapped in acid free paper (article code: UT3040 from Shades International Srl, Milan, IT) and placed in open plastic boxes. Fragmented bones were also wrapped in acid free paper, and then placed in polyethylene plastic bags for storage.

5.2.1.1 Skeletal Inventory

During the skeletal inventory detailed information was recorded on presence and absence of bones and teeth, completeness of the skeletal elements, and the grade of bone surface preservation (Buikstra and Ubelaker, 1994; Brickley and McKinley, 2004). Photographs were taken with digital cameras (Panasonic Lumix TZ8 Compact Digital Camera, Canon EOS 550D) equipped with a Canon zoom lens EF-S 18-55mm using the camera built in natural light (white point correction ON). Skeletons were photographed in the anatomical position followed by close-up photographs of bones and teeth showing pathological lesions. A centimetre scale plus an identification label were included in each photograph in order to gather a detailed visual recording of the osteological collection (Figure 5.1).

Figure 5.1 New bone formation and osteophytes at the left talus and calcaneus, burial T14 Loreto Ap.-Cappuccini (50+ years old male). Photos by the author.

5.2.1.2 Post Excavation Commingle

The Moscufo Via Petrarca cemetery was subjected to a different inventory procedure. The post excavation procedure did not follow standard practices and the skeletons were collected without being separated and stored with their burial number. This resulted in having more than one skeleton per box from this cemetery. The boxes containing multiple skeletons were inventoried following the required procedures applied for commingled remains (Brickley and McKinley, 2004). However, in some instances, it was possible to re-assemble individual skeletons by carefully examining and comparing stains on bone surfaces, or breakages on bone epiphyses, with the pictures of the skeletons taken *in situ* during the excavation. This method worked because the skeletal elements were clearly recognisable by meticulous examination of the pictures. Bones were assigned to a skeleton only in those cases when bones and pictures were matching.

5.2.1.3 Skeletal Completeness

Skeletal completeness was assessed following Buikstra and Ubelaker (1994, p. 6). Three scores were assigned to any bone element present for each of the two areas (axial skeleton and appendicular skeleton), according to the following scheme:

0 = absent

1 = "poor" if <25% of bone is present

2 = "partial" if between 75% and 25% of bone is present

3 = "complete" if >75% of bone is present

Small bone fragments were counted and grouped, where possible, into appropriate sections (Table 5.3). The assessment of the skeletal completeness and the evaluation of bone preservation, as well as, dental inventory and dental completeness (Sections: 5.2.1.4, 5.2.1.5 and 5.2.1.6), were fundamental procedures selected in this research in order to account for any bias occurring during a palaeodemographic assessment or in the calculation of the prevalence rates of pathologies affecting the skeleton.

Table 5.3 Summary of the areas, sections and bone elements observed to assess the skeletal completeness.

Areas	**Sections**	**Bone elements**
Axial skeleton	Skull	All elements scored separately
	Sternum	Manubrium, sternum, xyphoid
	Vertebrae	Body, neural arch, spine, unknown and un-sided
	Ribs	1 to 12, unknown and un-sided
	Sacrum	S1-S5, coccyx
Appendicular skeleton	Scapulae	Body, acromion, glenoid cavity, coracoid
	Clavicles	Medial epiphysis, diaphysis, distal epiphysis
	Pelvis	Ilium, ischium, pubis
	Upper and lower long bones	Proximal joint surface (Prox J.S.), proximal epiphysis (P1/3), medial diaphysis (M1/3), distal epiphysis (D1/3), distal joint surface (D J.S.)
	Hands and feet	Carpals, metacarpals / Tarsals, metatarsals.
	Phalanges	Proximal, middle, distal, unknown and un-sided

5.2.1.4 Taphonomy

Bone surface preservation was recorded following the recommendations by Brickley and McKinley (2004), with additional information on bone colour, presence of stains, and weathering stages (Behrensmeyer, 1978; Buikstra and Ubelaker, 1994, pp. 141–152). Modification due to erosion/abrasion was scored from grade 0 (surface morphology clear, no visible modification) to grade 5 (surface profile modified with clear presence of erosion) (Table 5.4). Each bone element might be affected differently thus surface modification was recorded for each segment of the bone. Similarly, weathering was scored from stage 0 (no sign of cracking or flacking) to stage 5 (evident deterioration and shape difficult to determine). Bleaching and discolouration were recorded, specifying the extent and colour of the cortical surface of the bone. Evidence of surface damaged caused by animals gnawing, plant roots, burning or other environmental factors, was marked with specification on nature of marks, number and the extent of area covered. Bone colour was described as variable between natural/ivory to grey and black, whilst stains referred to the nature of the stain and possible objects in contact with the bone surface. Finally, 'curator modifications' was described as modifications due to events that might have occurred post- excavation. Table 5.4 summarises taphonomic alterations recorded for each bone element. Each bone was observed macroscopically and, where needed, using a magnifying glass.

Table 5.4 Taphonomic alterations recorded for each bone element.

Bone surface modification	**Specific observations**
Erosion/Abrasion	Grades 0 to 5
Weathering	Stages 0 to 5
Bleaching and discolouration	Presence; Extent; Bone colour
Surface damaged (animal gnawing, root plants, burning, or other)	Nature of marks; Number; Extent of area covered
Bone colour	Natural/Ivory; Cream; Yellow; Light brown; Dark brown; Grey; Black
Stains	Green/Blue (copper); Iron/Ferrous metal; soil; Mottled pattern; Fungi
Curator modifications	Post-excavation modification

5.2.1.5 Dental Inventory

A dental inventory was conducted for every tooth following the standards by Brickley and McKinley (2004, p. 8). Deciduous and permanent dentitions were recorded using two different grids, modified from the Zsigmondy system. Individual teeth were exhamined and classified into one of the categories present in Table 5.5.

Table 5.5 Dental notation categories.

Code	Specific observation	Code	Specific observation
Blank	Present	c	Caries
/	Tooth lost post mortem	b	Broken tooth
-	Tooth present but socket missing	a	Abscesses
x	Tooth lost ante mortem	e	Tooth erupting
np	Tooth not present	u	Tooth unerupted
--	Tooth and jaw not present	w	wear

Stages of occlusal dental wear were recorded according to Smith's (1984) protocol. Stages of tooth development were recorded following Buikstra and Ubelaker's (1994) standards. In addition, a visual inventory was created for each individual, and each single tooth was recorded for presence or absence, location and extension of carious lesions, and dental wear severity. The visual inventory was diversified according to the age range of the observed skeleton; thus, the drawing of the deciduous dentition was used for infant skeletons, both the deciduous and the permanent dentition drawings were used for juvenile skeletons, and the permanent dentition drawing was used for adult skeletons. Detailed recording of dental pathology will be covered in section (5.2.4.1).

5.2.1.6 Dental Completeness

Dental completeness was assessed for each skeleton to provide a general percentage of teeth present. The dentition of each skeleton was examined and classified into one of the following categories:

0 = No teeth (lost antemortem)

1 = Complete (teeth present postmortem, likely to be present antemortem)

2 = Nearly complete dentition (some teeth lost postmortem but >50 present from the determined antemortem dentition)

3 = Partial dentition (<50% of antemortem dentition is present)

5.2.2 Sex and Age Estimation

The present section (5.2.2) describes the methodologies used for assessing biological sex (5.2.2.1) and age estimation (5.2.2.2). Sex was assessed considering dimorphic differences expressed in adult and juvenile male and female individuals. The methodologies for estimating age described in section 5.2.2.2 focus on the evaluation of multiple parameters, e.g., dental development, epiphyseal fusion, dental wear, and bone surface degeneration.

5.2.2.1 Sex Estimation

The estimation of biological sex is one of the main procedures when reconstructing the demographic profile of a population. Biological sex is assessed by considering dimorphic differences in skeletal elements expressed in female and male individuals. It is important to consider multiple features before assigning sex, because in some cases a feature may not be sufficiently diagnostic to estimate biological sex of the skeleton. Biological sex for adult individuals was estimated by observing diagnostic skull and pelvic morphological features (Table 5.6) following Buikstra and Ubelaker (1994) and Acsádi & Nemeskéri (1970). Every dimorphic character was scored as female (F), probable female (F?), ambiguous (AM), probable male (M?), and male (M), and sex was estimated by combining all the assessments (Phenice, 1969; Ferembach *et al.*, 1980; Schwartz, 2006). Osteometrics, for example the measurement of the femoral head and the length of the glenoid cavity of the scapula (Table 5.6), were used as an additional indicator (Brickley and McKinley, 2004). Skeletal features selected for the assessment of sex varied widely across the skeletons depending on the level of bone preservation. Sex estimation of the immature individuals was not attempted in this study.

Table 5.6 List of the diagnostic characters observed to assess the biological sex in each skeleton. Include citations/sources here as well-- based on Acsádi & Nemeskéri (1970), Buikstra and Ubelaker (1994, p. 15) and Brickley and McKinley (2004, p. 23).

Visual assessment of skull and mandible	**Visual assessment of pelvis and sacrum**	**Metrical analysis**
Glabellar profile	Greater sciatic notch	Femoral head measurements (Superior-Inferior, Medio-Lateral)
Fontal slope	Auricular surface	Length glenoid cavity
Zygomatic bone	Preauricular sulcus	
Suprameatal crest	Acetabulum	
Mastoid process	Pubic rami	
Nuchal area	Sub-pubic concavity	
External occipital protuberance	Ischial spine	
Mandibular ramus (ant-post)	Width of sacral ala	
Depth from incisors to mentum		
Lower margin of mandibular corpus		
Angle of mandible		

5.2.2.2 Age Estimation

The methods employed for age estimation are based on the evaluation of morphological changes that are evident in specific areas of the skeletons considered to be related with chronological growth (Brickley and McKinley, 2004) (Table 5.7). Immature age was estimated evaluating the stage of dental development (Moorrees *et al.*, 1963; Ubelaker, 1989) and epiphyseal fusion (Schaefer *et al.*, 2009). Infants and children were aged according to the stages of tooth development, as dental growth is controlled by genetic factors and environmental stresses impact less on the degree of development; this provides a more accurate indicator of age at death for this age group (Bennike *et al.*, 2005, p. 736; Hillson, 2014). Differently, the age estimation of juveniles was carried out using both tooth development and epiphyseal fusion.

Multiple methods were utilised to estimate the age-at death of adult individuals (Table 5.7). The dental wear method proved to be the most relevant one due to the high degree of bone fragmentation (Miles, 1963, 2001). The degeneration of the pubic symphysis (Brooks and Suchey, 1990), the auricular surface of the ilium (Lovejoy, 1985; Buckberry and Chamberlain, 2002), and the observation of cranial sutures closure (Meindl and Lovejoy, 1985) were used only when the diagnostic traits were clearly observable.

Table 5.7 List of methodologies used to estimate the age-at death of juvenile and adult individuals.

Method	**Age range**	**References**
Dental development	Immature	Moorrees *et al.*, 1963, Ubelaker, 1989
Epiphyseal fusion	Immature	Shaefer *et al.*, 2009
Dental wear	Adults	Miles, 1963, 2001
Pubic symphysis degeneration	Adults	Brook and Suchey, 1990
Auricular surface degeneration	Adults	Lovejoy *et al.*, 1985 Buckberry and Chamberlain, 2000
Cranial suture closure	Adults	Meindl and Lovejoy, 1995

Different age categories have been defined and applied for immature and adult individuals in bioarchaeological research (Lewis, 2007; Scheuer and Black, 2000b, pp. 468–469). For the present study skeletons were included in one of the age ranges shown in Table 5.8 (Buikstra and Ubelaker, 1994).

Table 5.8 Age ranges defined for the present study (Buikstra and Ubelaker, 1994).

Age range	**Age**
Foetus	In utero – 40 weeks
Infant	0 - 3 years
Child	3 - 12 years
Juvenile	12 - 20 years
Young adult	20 - 35 years
Middle adult	35 - 50 years
Old adult	50+ years

5.2.3 Stature and Body Mass Estimation

The following sections are dedicated to the methodologies employed for estimation of stature (5.2.3.1) and body mass (5.2.3.2). Stature was estimated from complete femora and tibiae using Pearson's regression equations. Body mass was estimated considering the linear regression equations developed in Ruff *et al.* (1991).

5.2.3.1 Estimation of Stature

Stature was estimated by using Pearson's regression equations which rely on the measurements of complete long bones and the conversion to height values (Pearson, 1899). Sparacello *et al.* (2017) estimated the stature of several Samnite populations from Abruzzo using different regression methods to identify the best method. The authors noticed that Pearson's formulae provided the best stature estimates for both males and females, therefore, they decided to employ these formulae for calculating stature estimates for their sample. Being the populations considered in this study part of the populations groups inhabiting the Abruzzo region, Pearson's regression equations allowed to obtained stature estimates which could have been compared to the populations included in Sparacello's *et al.* (2017) publication, with a high degree of accuracy.

Measurements were done using an osteometric board and digital sliding calipers. Femora and tibiae were chosen to estimate stature for two reasons: firstly, they give smaller associated error (Brickley and McKinley, 2004, p. 33), and secondly, these bones were most often better preserved than upper limb bones. Right and left measurements were considered based on which was present and better preserved. When right and left bones were present the mean was used for stature estimation. According to Trotter and Gleser, (1952), the standard deviation correspondent to the values of right and left bones is very small with an insignificant difference between sides. Upper limb metrics were included only when femora and tibiae were absent, and same procedure was adhered to for lower limb bones. Bone measurements were repeated three times per each individual and left and right measurements were averaged and used as value for the regression equation. Regression formulae obtained from populations with body proportions similar to the one under study were preferred (Sjøvold, 1990; Brickley and McKinley, 2004, p. 33) maximum and bicondylar lengths were measures for complete bones. The regression equations used in this study are listed in Table 5.9.

Table 5.9 Regression equations use to estimate the stature of the skeletons (after Pearson, (1899)). S = stature; F = femur maximum length measured from top of head to bottom of internal condyle; H = humerus maximum length measured from top of head to lowest point of internal margin of trochlea; T = tibia length measured from plane of upper articular surfaces to tip of internal malleolus; R = radius length measured from top of head to tip of styloid process.

Regression equations (cm)	
Male	**Female**
S = 81.306 + 1.880 x F S = 70.641 + 2.894 x H S = 78.664 + 2.376 x T S = 85.925 + 3.271 x R	S = 72.844 + 1.945 x F S = 71.475 + 2.754 x H S = 74.774 + 2.352 x T S = 81.224 + 3.343 x R

5.2.3.2 Body Mass Estimation

Body mass was estimated measuring the superior and inferior breadth of the femoral head in individuals whose skeletal maturity was ascertained (at least 18 years old). In this study a mechanical approach was preferred to the morphometric ones, since the absence of well-preserved skeletal elements did not allow for the morphometric approach. Right and left measurements were considered based on which side was present and better preserved. When both bones were present, left and right measurements were averaged to reduce laterality biases and used as value for the linear equations (Auerbach and Ruff, 2004, 2006). Formulae developed by Ruff *et al.* (1991) were employed for body mass estimation in males, females, and combined sex (Table 5.10).

Table 5.10 Linear regression equations to estimate the body mass. Measures are expressed in millimetres (mm) and the body mass index in kilograms (Kg) (after Ruff et al., 1991). BM = body mass; FH = femoral head.

Regression equations
BM = (2.741 x FH - 54.9) x 0.90 (males)
BM = (2.426 x FH – 35.1) x 0.90 (females)
BM = (2.160 x FH – 24.8) x 0.90 (combined sex)

5.2.4 Individual Health

The way in which health history of the skeletal sample was assessed is described in the following sections. Diseases affecting the oral cavity (5.2.4.1) and skeletal elements (5.2.4.2) are useful to investigate the health and diet of the individuals. The assessment of tooth and bone lesions were conducted by means of a detailed description and documentation of the pathological evidence found in the skeletons.

5.2.4.1 Oral Health

The methodologies used to evaluate carious lesions, periapical lesions, calculus, periodontitis, antemortem tooth loss (AMTL) and enamel hypoplasia are reported below. Tooth wear, which has been used as indicator of aging, will be considered as a disease only when the wear affected the alveolar bone.

5.2.4.1.1 Carious Lesions

Permanent and deciduous teeth were examined macroscopically for carious lesions, using a 10x triplet hand lens. The assessment of the prevalence and severity of dental caries was pivotal, as the presence of caries provides insights into the nutritional, biological and environmental factors an individual was exposed to (Lukacs and Largaespada, 2006). Carious lesions were scored as present if a slight stain with a small cavity was visually observable on the tooth surface. Location (aspect, number, surface) and severity of the lesion were recorded for each tooth presenting the lesion (Buikstra and Ubelaker, 1994; Hillson, 2001). As a result, for each tooth the following were recorded concerning carious lesions:

- Tooth affected by the lesion
- Location: coronal, cervical (cemento-enamel junction), and root
- Aspect: occlusal, buccal, lingual, mesial, and distal
- Severity: initial pit/fissure formation, between pit and < 1/2 of surface affected, > 1/2 surface affected, complete destruction of tooth, indeterminate

Severity was recorded as indicated by the standards, however the analysis of severity of carious lesions was addressed, in this study, quantifying the number of affected teeth per skeleton. Indices from 0 to 4 were given to each skeleton according to the number of teeth with caries: 0 = no dental caries; 1 = 1tooth affected, 2 = 2 teeth affected, 3 = 3 teeth affected, 4+ = 4 or more teeth affected.

5.2.4.1.2 Periapical Lesions

Periapical lesions were recorded as "present" when a drainage fistula was visible on the mandible or maxilla. The location of the drainage (lingual, buccal, or maxillary sinus) was assessed followed by the determination, where possible, of the cause of the periapical abscess, such as caries or wear (Brickley and McKinley, 2004). The severity was calculated quantifying the number of affected teeth per skeleton. Indices from 0 to 4 were given to each skeleton according to the number of teeth presenting the lesion: 0 = no periapical lesions; 1 = 1 tooth affected, 2 = 2 teeth affected, 3 = 3 teeth affected, 4+ = 4 or more teeth affected.

5.2.4.1.3 Calculus

To score the quantity of calculus present on the dentition the method presented by Dobney and Brothwell (1987) was used. Each tooth was examined macroscopically with the use of a 10x Triplet Hand Lens. The grade (0 to 4), thickness range in mm, percentage of crown covered (none to 70%) and calculus profile (flat, slightly wedge-shaped, obviously wedged-shaped, and thick wedge-shaped) were recorded. The degree of calculus deposits was assessed because it provides valuable information on the diet and oral hygiene of individuals, as its formation is frequently associated with the presence of an alkaline oral environment, often linked with a protein-rich diet (Hillson, 1996). In addition, the assessment of dental calculus gives a broader understanding of the individuals' oral health when evaluated together with the prevalence of periodontal disease.

5.2.4.1.4 Periodontitis

The degree of the alveolar bone recession was scored using a stainless-steel graduated Periodontal William Probe (Preshaw, 2015). Severity was recorded using Brothwell (1981) assigning indices as follow: 1 = 2-3 mm, 2 = 3-5 mm, 3 = majority of tooth root exposed (Brickley and McKinley, 2004). A condition was considered pathological when the resorption was over 2 mm from the cementum-enamel junction to the alveolar margin, additional to the presence of porosity of interradicular and interdental septa. The presence of swelling of the alveolar cavities was recorded as sign of periapical lesions.

5.2.4.1.5 Dental Wear

Maxillary and mandibular teeth were observed macroscopically for the presence of dental wear. The stages of wear were scored following the indications suggested by Buikstra and Ubelaker (1994) standards. However, in this thesis only the Smith's (1984) system was used. Stages of wear from 1 to 8 were used for molars, premolar, canines, and incisors. Average wear was calculated separately for maxillary and mandibular teeth to evaluate the overall extent of wear pattern for single individual.

5.2.4.1.6 Antemortem Tooth Loss (AMTL)

Upper and lower dental arcades of and adult skeletons were observed macroscopically for AMTL. It was scored as present when the dental cavity was partially or completely remodelled. The severity was calculated by quantifying the number of affected teeth per skeleton. Indices from 0 to 4 were given to each skeleton according to the number of teeth lost antemortem: 0 = no teeth lost antemortem; 1 = 1 tooth affected, 2 = 2 teeth affected, 3 = 3 teeth affected, 4+ = 4 or more teeth affected. Skeletons where the presence of AMTL is uncertain were not considered in this part of the analysis.

5.2.4.1.7 Dental Enamel Hypoplasia (DEH)

In the present study enamel hypoplasia was recorded for both mandibular and maxillary teeth based on macroscopic observation. Deciduous and permanent dentition were closely examined using a 10x 'triplet hand lens', and presence or absence of the enamel defect was recorded. Individuals with only one tooth displaying a hypoplastic defects or with gross tooth wear were excluded from this study. When there were further signs of hypoplasia, other features were scored following the guidelines described in the Brickley and McKinley's (2004) standard, which are listed below:

- Number: number of lines or pits present on the tooth
- Type of defects: linear horizontal groves, linear vertical groves, linear horizontal pits, non-linear array of pits, single pits

- Position on the tooth crown: 1 = cusp, 2 = middle section of the crown, 3 = neck
- Severity: 1 = discernible line, 2 = clear groove, 3 = gross defects
- Hypocalcification (different from post-mortem discolouration): yellow, cream/white, orange or brown

5.2.4.2 Skeletal Health

5.2.4.2.1 Non-Specific Infectious Disease

The presence of markers of non-specific infectious disease was evaluated and scored for the entire collection. Each skeletal element was examined for the presence of abnormal new bone formation on periosteal and endosteal surfaces, and presence of bone loss. Skeletons with high degree of erosion on inner and outer layers of the cortical surface were excluded from the recording, as were fragmentary bones. Periosteal bone formation and bone loss were recorded following the parameters listed in Figure 5.2.

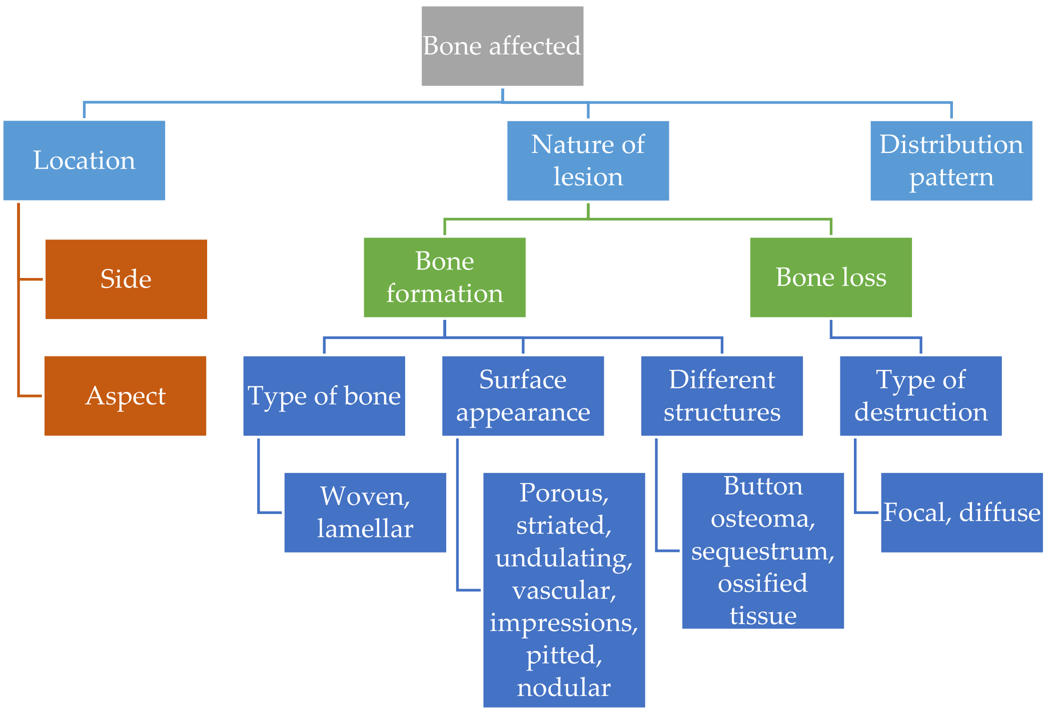

Figure 5.2 Parameters employed in the present study for recording abnormal bone formation and bone loss (after Buikstra and Ubelaker, 1994).

5.2.4.2.1.1 Endocranial Lesions

All available skulls with moderate preservation of the endocranial surface were examined for evidence of endocranial lesions. Endocranial lesion was diagnosed when reactive new bone formation was present on the endocranium surface. If present, the lesions were scored as: 0 = no lesion; 1 = pitted lesion; 2 = deposits of white or grey, fibre or immature new bone; 3 = capillary formations; 4 = 'hair-on-hand' formation (Lewis, 2004). Location of the lesion was also recorded. New bone formation on the endocranium resulting of a traumatic event (e.g., cranial trauma) was not recorded as endocranial lesion.

5.2.4.2.1.2 Maxillary Sinusitis

Maxillary sinuses inflammation was diagnosed when smooth abnormal bone deposition was present within the sinuses. The maxillary sinuses of adults and individuals aged over 3 were macroscopically examined. Infants and younger children were not included in the assessment, as the maxillary sinuses are still forming and this does not allow for an effective evaluation (Lewis, 2007). Maxillary sinusitis was recorded following Boocock's *et al.* (1995) criteria, and attention was given to record other possible aetiology factors. Studies in this field of research have documented the existence of a connection between maxillary sinusitis and the conditions in which individuals live. Poor ventilation, irritation of the respiratory track due to agricultural activities, dental diseases, caries and abscesses, all these factors can contribute to cause maxillary sinusitis (Boocock *et al.*, 1995; Lewis *et al.*, 1995; Roberts, 2007).

5.2.4.2.2 Cribra Orbitalia

Presence and severity of pathological changes affecting the cortical bone within the orbits (cribra orbitalia) were scored following Stuart-Macadam (1991). The macroscopic observation of the affected areas resulted in the inclusion in one of the following six categories:

0 = Normal bone surface

1 = Capillary impressions

2 = Scattered fine foramina

3 = Large to small isolated foramina

4 = Trabecular structure

5 = Trabecular outgrowth

The assessment included immature and adult skeletons that had at least one orbit and the 75% of cranial vault present, with moderate to good state of bone surface preservation.

5.2.4.2.3 Joint Disease

The present section has been divided in two different sections; the first covers the methodology applied to record appendicular joint diseases, not including the spine (5.2.4.2.3.1), the second covers the methodology to record the degenerative joint disease of the spine as well as Schmorl's nodes (5.2.4.2.3.2).

5.2.4.2.3.1 Appendicular Joint Disease

The appendicular skeleton of adult individuals was observed macroscopically for presence or absence of articular diseases. Each joint (shoulder, elbow, hip, knee, wrist, hand, ankle, and foot) was examined separately at first, and then considered as a whole for the analysis of the pathological condition of the joints. The condition of each joint surface was observed and evaluated for the presence/absence of: 1) osteophytes, which is the initial manifestation of joint disease; 2) porosity; 3) eburnation, which represents a more severe stage of the disease; and 4) surface erosion, which consist on the complete destruction of the joint and the loss of its original shape. The degeneration of the appendicular joints was scored according to Steckel *et al.* (2006, pp. 32–33) criteria, adapted from Schultz (1988) (Figure 5.3). The scoring grades are:

0 = Joint not available for observation

1 = Joint shows no evidence of pathological changes

2 = Slight marginal lipping (osteophytes less than about 3mm) and slight degenerative or productive changes are present (Left hand column: less than

50%, right hand column: more than 50%). No eburnation is present, but the surface may include some porosity

3 = Severe marginal lipping (osteophytes greater than about 3mm) and severe degenerative or productive changes are present. The white area corresponds to eburnation. The surface may include substantial porosity

4 = Complete or near complete (more than about 80%) destruction of articular surface (margin and face), including ankylosis

5 = Joint fusion (synostosis)

Osteoarthritis (OA) was diagnosed as present only when eburnation was seen or when both marginal lipping and porosity were clearly visible (Waldron, 2009).

Figure 5.3 Standard for scoring appendicular degenerative joint diseases (Steckel et al., 2006: 32,33).

5.2.4.2.3.2 *Pathological Condition of the Spine*

Each vertebra was observed macroscopically for presence or absence of degenerative changes in the spine. Synovial (apophyseal) and fibrous (intervertebral body articulations) joints were analysed for signs of degenerative disease. Only the vertebrae with moderate and good surfaces preservation were included in the examination. When vertebral osteophytes were visible, the location of the marginal lipping (superior/inferior body, superior/inferior process, transverse process, coastal facets), the degree of expression, and the presence of porosity were recorded using Buikstra and Ubelaker (1994) standard, as follows:

1 = Barely discernible vertebral osteophytes

2 = Vertebral osteophytes with elevated rim

3 = Curved spicules

4 = Fusion of the spicules present

If porosity was present in association with the osteophytes, its location was recorded (along the margin of vertebral body and/or extended within the endplate of the vertebral body). Schmorl's nodes (SN) were recorded if present and the following points were evaluated: the vertebra affected, location, and the morphology of the defects (depression only or remodelling), and the extent of the depression. Indices were given as follows:

0 = Joint not available for observation

1 = SN present on one vertebral body

2 = SN with severe depression on one vertebral body

3 = SN present on both vertebral bodies

4 = SN with severe depression on both vertebral bodies

In addition, the skeletons were observed for vertebral anomalies, this involved the recording of presence or absence of the anomaly (e.g., sacralisation of L5, spina bifida), location, and the description of the identified defect.

5.2.4.2.4 Trauma

Presence of fractures were recorded following Brickley and McKinley (2004) and Lovell (1997). Information recorded about fractures included: 1) identification of a callus, 2) identification of the bone affected (name and side), 3) identification of the type of fracture (spiral, transverse, oblique, greenstick, compression, comminuted, depression), 4) identification of the mechanism of injury (direct, indirect), 5) identification healing process, and 6) identification of complications (non-union, presence of infection, necrosis). A detailed description of the lesions was accompanied by photographic and radiographic documentations. A NomadPRO Dental X-Ray unit was used to assess by radiographic observations the degree of traumatic lesions affecting the bones of individuals presenting unusual evidence of trauma and extent of healing.

5.2.5 Three-Dimensional and Chemical Methodology for Reconstructing Diet and Mobility

5.2.5.1 Microwear Surface Texture Data Acquisition

Adult teeth selected for the microwear surface texture analysis were first photographed to have a record of the crown surface. The teeth were prepared in the Osteology Research Lab, University of Kent under the guidance of Dr Patrick Mahoney. The occlusal surface of each tooth was cleaned to remove the dirt using 90% ethanol and cotton wool (Figure 5.4a).

a) b) c)

Figure 5.4 Steps carried out to make negative and positive casts of the tooth occlusal surface: a) shows the tooth selected for casting (upper left M2); b) the tooth surface covered with silicon-based impression material to make the impression; c) negative cast filled with resin to produce the positive cast. Photos by the author.

A negative impression of the occlusal surface was taken using a silicon-based impression material surface activated (Coltène-Whaledent Lightbody, President Jet®). After discarding the first impression to eliminate any possible dirt residue on the surface, a second impression was used to create a positive impression (Figure 5.4b). This impression was set into a dental putty (Coltène-Whaledent, President Putty®). The cast was filled with an epoxy resin (Buehler EpoxiCure®) to produce the positive cast of the occlusal surface (Figure 5.4c). The epoxy resin cast was left to cure for 24 hours, before the surface texture analysis.

The observation and calculation of the microwear present on the occlusal surface were performed by Dr. Christopher W. Schmidt at the Indiana Prehistory Laboratory, University of Indianapolis, following the guidelines reported in Schmidt *et al.* (2015). A Solarius Sensofar Plμ white light confocal profiler (WLCP) was used to examine the casts. Facet 9 was preliminary observed at a 10X magnification, areas of interest were later analysed at 100X magnification using a 100X-EX long distance lens. The data were collected from an area of 276 x 204 μm and imported into SolarMap® (version 5.1.1). The data clouds were levelled and non-microwear features removed, a SEM inspection and a 3D representation were performed to closely determine and validate the true microwear features visible on the surface. The analysis of the surface characteristics was performed using two programs, Sfrax® and Toothfrax®, which yielded the complexity (Asfc) and the anisotropy (epLsar) values (Scott *et al.*, 2006).

5.2.5.2 Carbon and Nitrogen Isotope Data Acquisition

The dentine sampling was conducted at the Institució Milà i Fontanals, Consejo Superior de Investigaciones Científicas-Spanish National Research Council (IMF-CSIC), Barcelona, Spain by Dr Valenzuela. A quarter of each tooth crown was removed using a dental drill with attached a diamond-coated cutting disk (Figure 5.5a). The dentine fraction was carefully removed and collected for the analysis, leaving approximately from 5 g of dentin powder sampled (Figure 5.5b).

a) b)

Figure 5.5 Sampling procedure: a) cutting of the tooth crown using a dental drill with attached a diamond-coated cutting disk; b) removing of the dentine fraction. Photos by the author.

Sample preparation and analysis were performed at the University of Campania 'Luigi Vanvitelli' (Italy) by Professor Lubritto. The samples were analysed using DELTA V™ Advantage Isotope Ratio Mass Spectrometer, Integrated with Thermo Scientific FlashEA™ 1112 elemental analyser. The isotopic ratios of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) are expressed using the delta scale in units of "per mil" (‰) relative to internationally accepted standards. Pee Dee Belemnite (PDB) for carbon and AIR for nitrogen. The reliability of the measures was tested by repeating the measurements using five different internal standards (CH3, CH6, YEAST, N2, USGS34) for each single sample (Ricci *et al.*, 2016; Lubritto *et al.*, 2017).

5.2.5.3 Strontium Isotope Data Acquisition

The enamel sampling was conducted at the Institució Milà i Fontanals, Consejo Superior de Investigaciones Científicas-Spanish National Research Council (IMF-CSIC), Barcelona, Spain. The enamel surface of each tooth was first cleaned with an abrasive material to remove all the superficial contamination. A quarter of each tooth crown was cut using a dental drill with attached a diamond-coated cutting disk (Figure 5.5a). Approximately 4 g of enamel powder were collected for the strontium isotope analysis.

Strontium isotope sample preparation and analysis were performed at the Trace Research Centre, Nereto (TE), Italy. Thermal ionisation mass spectrometry (TIMS) with Finnigan 262 VMC multi-collector was used to measure strontium isotope composition and concentrations. The $^{87}Sr/^{86}Sr$ ratio was normalised to SRM 987 (NIST-USA) standard and the δ‰ values $^{87}Sr/^{86}Sr$ ratios were obtained from formula (a):

$$\delta\,(‰) = {}^{87}Sr/{}^{86}Sr_{analyser} \,/\, {}^{87}Sr/{}^{86}Sr_{standard} - 1) \times 1000 \qquad \text{(a)}$$

5.2.6 Gender, Roles and Social Status

Two datasets were constructed to collect and summarise all the information concerning the funerary context of the study sites. Changes in funerary deposits and burial structures were investigated for the whole sample by age category (adults, juveniles, and infants and children) and by biological sex (females, males).

5.2.6.1 Gender and Roles

The grave good dataset was compiled to record information on every single object recovered, this was based on published materials on the relevant investigated cemeteries. The grave goods were subsequently grouped into six broad categories according to the typology and function of the objects (Table 5.11).

The study of gender and roles in the present assemblages was done following the osteological examination of the individuals' biological sex. Objects present in biologically sexed female and male individuals were analysed and gender and roles evaluated in relation to the typology of objects found in the burials. Objects present only in female burials were considered as representative of female gender, and objects present only in male burials were considered as representative of male gender.

Table 5.11 Categories used to group funerary deposits.

<table>
<tr><th colspan="3">Funerary deposits</th></tr>
<tr><td colspan="2">Jewellery</td><td>Necklace, isolated beads, pendants, cypraea shell, circular disks, torque, diadem, bracelet, armilla</td></tr>
<tr><td colspan="2">Dress accessories</td><td>Bronze fibulae, iron fibulae, line of bronze rings, belt, shoes+crampons</td></tr>
<tr><td colspan="2">Textile-working tools</td><td>Needle, spindle, spindle-whorl, reel</td></tr>
<tr><td colspan="2">Combat-related objects</td><td>Armour, sword, spearhead</td></tr>
<tr><td colspan="2">Food and hygiene-related metal objects</td><td>Tweezers, razor, spit, strainer, knife/dagger</td></tr>
<tr><td rowspan="6">Ceramic and metal vessels</td><td>Food/liquid container</td><td>Olla, small olla, bronze cauldron, bronze bowl</td></tr>
<tr><td>Drinking vessels</td><td>Cup, mug, kantharos, skyphos</td></tr>
<tr><td>Pouring container</td><td>Olpe, jug, oinochoe</td></tr>
<tr><td>Wine container</td><td>Amphora, krater</td></tr>
<tr><td colspan="2">Attic wares</td></tr>
<tr><td colspan="2">Others</td></tr>
</table>

Burials with no grave goods and those where grave goods could not be assigned a specific gender (neither weapons nor jewellery) were defined as "no gender" and "neutral" respectively (Lucy, 1998, 2000). Burials with unsexed skeletons, due to poor bone preservation or absence of diagnostic anatomical parts, were considered potentially males or females according to the objects buried with them.

5.2.6.2 Social Status

The expression of status of the studied individuals was investigated by considering multiple aspects. One of the aspects involved the differences in typology of the burials. The burials were classified in three distinct typologies: 1) graves organised in two levels, with the large *olla* halfway up the wall of the burial pit; 2) graves with the *olla* placed together with the skeleton in the lower level; and 3) graves without the *olla* present. In the burial assemblages the listed differences were evaluated and recorded, along with the grave goods. The number of grave goods in the burials and the typology of objects (the material of the artefacts, local or imported) were additional aspects considered in this study to understand social hierarchy and social dynamics within and across the studied cemeteries.

5.2.7 Statistical Tests and Data Analysis

Statistical analyses with a 95% confidence interval were performed to assess validity and significance of the recorded data, and tests were selected according to the combinations of variables being analysed. IBM SPSS (Statistical Package for Social Science) Version 26 was used to perform all the statistical tests. The first phase of the data analysis involved the use of descriptive statistics, which enabled the description of the samples' characteristics, the summary of the data, and the checking of the variables. The normality of the distribution of scores were assessed using Shapiro-Wilk because of the small sample size analysed. Parametric (Student t test) and nonparametric (Mann-Whitney's U test, Kruskal-Wallis H test) significance analyses were used to test the relationship between two or more variables once normality had been checked. Chi-square tests of independence (χ^2) were used in this study to identify correlations between categorical variables such as biological sex, age, and pathology. Fisher's Exact Tests were employed when counts within a category were less than 5 (Shennan, 1997).

Chapter 6 Results of the Indicators of Physiological Stress, Diet and Mobility in the Loreto Aprutino-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera Cemeteries

The results from the bioarchaeological study of Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries are presented in this chapter. The data of each pathological condition are reported as true prevalence rate (TPR). TPR was calculated dividing the number of individuals affected (n) by the number of individuals with one or more recordable skeletal element available for the analysis (N). TPR of each physiological condition was documented for the pooled sample as well as for each individual cemetery, and within each age and sex category. On several occasions it was necessary to group the sample in two broad age categories: immatures and adults. Infants, children and juveniles were grouped in the immature category, while the adult category comprised young adults, middle and old adults. Statistical analyses were run considering immatures and adults, and male and female categories due to small sample size.

6.1 Skeletal Completeness and Bone Surface Preservation

6.1.1 Skeletal and Dental Completeness

Skeletal and dental completeness of the sample (N=92 individuals) are presented in Table 6.1 and Table 6.2, respectively. More than half of the skeletons (55.7%) fall within the range of 25-75% complete, while the 13.6% was recorded as 75-100% complete. These data show that the skeletons were overall highly fragmented; however, 69.3% had bone elements available for the analysis. For dental completeness half of the skeletons (50.0%) exhibited nearly complete dentition with more than 50% of teeth present, while 20.5% had complete dentition. The absence of dentition was observed in 19.3% of the population. Individuals recorded with complete dentition and absent dentition were almost equally represented in the pooled sample.

Table 6.1 Skeletal completeness for each age category of the three analysed cemeteries. Pooled sample N = 92 individuals.

Age category	Completeness					
	0-25%		**25-75%**		**75-100%**	
	n	**%**	**n**	**%**	**n**	**%**
Foetus	–	–	–	–	–	–
Neonate	–	–	–	–	–	–
Infants	1	1.1	0	0.0	0	0.0
Children	3	3.4	2	2.3	0	0.0
Juveniles	4	4.5	13	14.8	3	3.4
Young adults	5	5.7	15	17.0	5	5.7
Middle adults	2	2.3	11	12.5	3	3.4
Old adults	4	4.5	7	8.0	1	1.1
Unknown age	12	13.6	1	1.1	0	0.0
Total	**31**	**35.2**	**49**	**55.7**	**12**	**13.6**

Table 6.2 Dental completeness for each age category of the three analysed cemeteries. Pooled sample N = 92 individuals.

Age category	No teeth present		Partial dentition (< 50% present)		Nearly complete dentition (> 50%)		Complete dentition	
	n	%	n	%	n	%	n	%
Foetus	–	–	–	–	–	–	–	–
Neonate	–	–	–	–	–	–	–	–
Infants	0	0.0	0	0.0	1	1.1	0	0.0
Children	1	1.1	1	1.1	3	3.4	0	0.0
Juveniles	2	2.3	1	1.1	11	12.5	5	5.7
Young adults	0	0.0	6	6.8	11	12.5	9	10.2
Middle adults	0	0.0	2	2.3	11	12.5	3	3.4
Old adults	1	1.1	3	3.4	7	8.0	1	1.1
Unknown age	13	14.8	0	0.0	0	0.0	0	0.0
Total	**17**	**19.3**	**13**	**14.8**	**44**	**50.0**	**18**	**20.5**

6.1.2 Bone Surface Preservation

The bone surface preservation calculated for the pooled sample (N = 92 individuals) is showed in Table 6.3. The majority of the sample showed good to moderate preservation (moderate 44.6%, good 22.8%), while 21.7% showed poor preservation. Only a small number of skeletons fall within the destroyed preservation category (10.9%).

Table 6.3 Degree of preservation for each age category of the three analysed cemeteries. Pooled sample N = 92 individuals.

Age category	**Destroyed**		**Poor**		**Moderate**		**Good**	
	Grade 5+		**Grade 5-4**		**Grade 4-3**		**Grade 2-1**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Foetus	_	_	_	_	_	_	_	_
Neonate	_	_	_	_	_	_	_	_
Infants	1	1.1	_	_	_	_	_	_
Children	_	_	4	4.3	1	1.1	_	_
Juveniles	_	_	3	3.2	12	13.0	4	4.3
Young adults	3	3.2	5	5.4	10	10.9	8	8.7
Middle adults	_	_	_	_	11	12.0	5	5.4
Old adults	_	_	4	4.3	5	5.7	3	3.2
Unknown age	6	5.7	4	4.3	2	2.2	1	1.1
Total	**10**	**10.9**	**20**	**21.7**	**41**	**44.6**	**21**	**22.8**

6.2 Demography

The mortality profile of the studied cemeteries is presented in Table 6.4 and Figure 6.1. The Loreto Ap.-Cappuccini cemetery consisted of N = 38 individuals (immatures: 26.3%, adults: 60.5%), Moscufo-Via Petrarca of N = 23 individuals (juveniles: 26.1%, adults: 39.1%) and Spoltore-Quagliera of N = 31 individuals (immatures: 29.0%, adults: 70.9%).

Table 6.4 Mortality profile of the studied cemeteries represented by the percentage of the population, N = 38 Loreto Ap.-Cappuccini, N = 23 Moscufo-Via Petrarca, N = 31 Spoltore-Quagliera. Percentages calculated on the total assemblage (N = 92) is also given. (n = number of individuals in each sex category, N = total number of individuals in each cemetery).

Age category	Age	Loreto Ap.-Cappuccini		Moscufo-Via Petrarca		Spoltore-Quagliera		Total	
		n	%	n	%	n	%	n	%
Foetal	<0	–	–	–	–	–	–	–	–
Infant	0 - 3 years	1	2.6	0	0.0	0	0.0	1	1.1
Children	3 - 12 years	4	10.5	0	0.0	1	3.2	5	5.4
Juveniles	12 - 20 years	5	13.2	6	26.1	8	25.8	19	20.7
Young adults	20 - 35 years	11	28.9	4	17.4	11	35.5	26	28.3
Middle adults	35 - 50 years	7	18.4	2	8.7	7	22.6	16	17.4
Old adults	>50 years	5	13.2	3	13.0	4	12.9	12	13.0
Unknown age	Unknown age	5	13.2	8	34.7	0	0.0	13	14.1
Total		**38**		**23**		**31**		**92**	

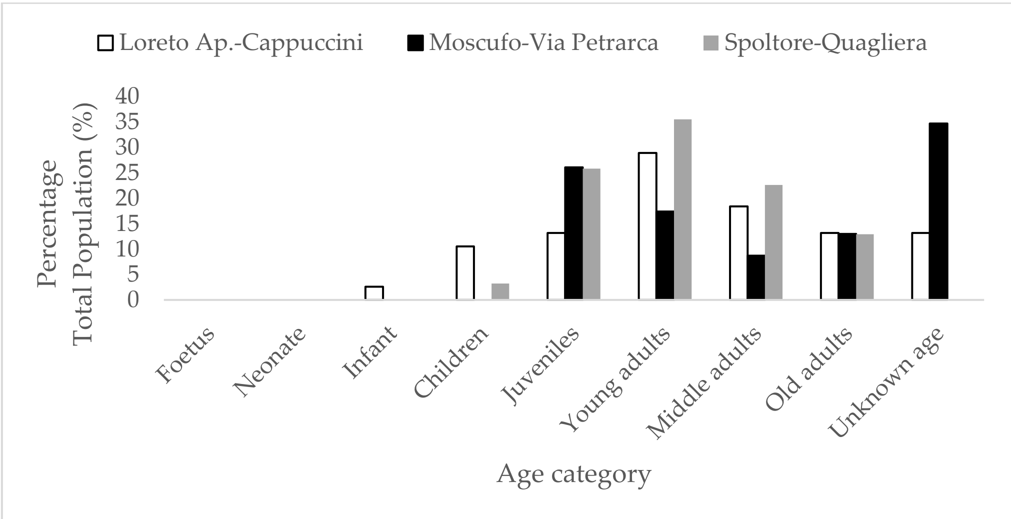

Figure 6.1 Mortality profile of Loreto Aprutino, Moscufo-Via Petrarca, and Spoltore-Quagliera cemeteries.

The mortality profile within the Loreto Ap.-Cappuccini cemetery, showed an increase from infants and children to juveniles (13.2%) with a peak in the young adult age category (28.9%) followed by a decrease in old adult age category (13.2%). In the Moscufo-Via Petrarca cemetery the highest percentage of mortality was observed within the juvenile age category (26.1%), followed by a reduction in the number of middle adults represented and then a slight increase in the old adult age category (13.0%). The mortality profile of Spoltore-Quagliera showed a rapid increase from children (3.2%) to juveniles (25.8%), peaking in the young adult age category (35.5%) followed by a decrease in the middle and old age categories. When comparing the three assemblages the highest percentage of mortality is observed in the juveniles and young adults age categories.

The biological sex distribution across the cemeteries is presented in Table 6.5. Of the 92 individuals with available skeletal elements, 75.0% (69/92) provided diagnostic elements for the biological sex estimation, of these 46.4% were females and 53.6% were males. When the cemeteries are considered separately, the prevalence of male individuals remained overall higher than the female ones.

Table 6.5 Biological sex distribution across the cemeteries (n = number of individuals in each sex category, N = total number of individuals in each cemetery).

Biological sex	**Loreto Ap.-Cappuccini**		**Moscufo-Via Petrarca**		**Spoltore-Quagliera**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Female	13	34.2	7	30.4	12	38.7	32	34.7
Male	12	31.6	9	39.1	16	51.6	37	40.2
Ambiguous	1	2.6	0	0.0	0	0.0	1	1.1
Immature	5	13.2	0	0.0	1	3.2	6	6.5
Unsexed	7	18.4	7	30.4	2	6.5	16	17.4
Total	**38**		**23**		**31**		**92**	

Age at death distribution was also analysed separately for female and male individuals. The results are presented in Table 6.6 and Figure 6.2. There were a higher number of males than females in the young adults and middle adults age categories (males - young adults 21.7%, middle adults 13.0%; females - young adults 11.6%, middle adults 10.1%). The opposite trend was observed in the old adult age category with a higher prevalence of females (13.0%) than of males (4.3%).

Table 6.6 Age at death and sex-related mortality. In the table individuals with known sex and age were considered. n = number of individuals in age and sex category, N = total number of individuals in each cemetery.

Age category	Sex	Loreto Ap.-Cappuccini		Moscufo-Via Petrarca		Spoltore-Quagliera		Total	
		n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Juveniles	Female	3	11.5	3	20	1	3.6	7	10.1
	Male	1	3.8	2	13.3	5	17.9	8	11.6
	Ambiguous	1	3.8	0	0.0	0	0.0	1	1.4
Young adults	Female	3	11.5	1	6.7	4	14.3	8	11.6
	Male	6	23.1	2	13.3	7	25	15	21.7
Middle adults	Female	3	11.5	1	6.7	3	10.7	7	10.1
	Male	4	15.4	1	6.7	4	14.3	9	13
Old adults	Female	4	15.4	1	6.7	4	14.3	9	13
	Male	1	3.8	2	13.3	0	0.0	3	4.3
Total		**26**		**15**		**28**		**69**	

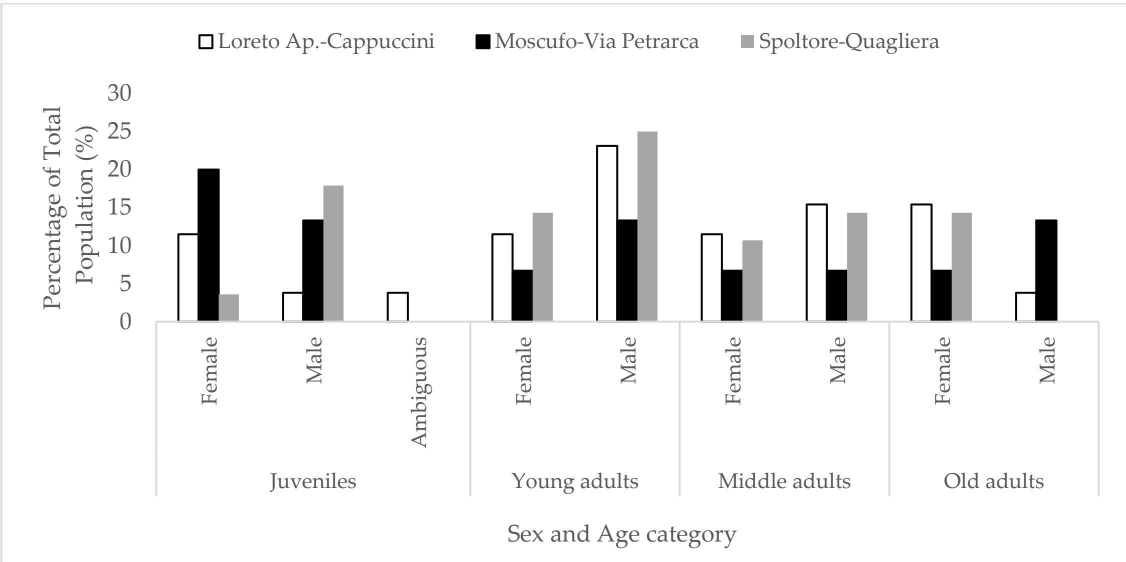

Figure 6.2 Biological sex and age profile for the three cemeteries. In this bar chart individuals of known se and age were considered.

Considering each cemetery separately, the proportion between the two sexes does not change consistently between the young and old adult age categories. The number of juvenile females was higher than of males in Loreto Ap-Cappuccini (female = 11.5%, male = 3.8%) and in Moscufo-Via Petrarca (female = 20.0%; male = 13.3%), while in Spoltore-Quagliera the number of juveniles males exceeds the number of females (female = 3.6%; male = 17.9%). The percentage of adult females and males was the same at Spoltore-Quagliera, but it was slightly different at Loreto Ap-Cappuccini (female = 38.4%; male = 42.3%) and Moscufo-Via Petrarca (female = 20.0%; male = 33.3%).

6.3 Stature and Body Mass

6.3.1 Stature

Femoral length was measured from 20 adult skeletons (10 females and 10 males). In this study, stature estimates were calculated by using regression equations developed on similar populations to those under examination and Pearson's (1899) formulae were preferred for comparative purposes. The mean values for stature of female and male individuals across different cemeteries are presented in Table 6.7. The mean stature of the present sample was 154.0 cm for females and 165.6 cm for males. When single cemeteries are considered, female and male individuals from Loreto Ap.-Cappuccini showed, respectively, the lowest and the highest mean statures (female = 152.5 cm, and male = 167.1 cm) compared to Moscufo-Via Petrarca and Spoltore-Quagliera.

Table 6.7 Mean values of estimated stature of female and male individuals from the three cemeteries (N = number of individuals with preserved femora).

Cemetery	Sex	N	Mean (cm)	Std. Deviation	Range (cm)
Loreto Ap.-Cappuccini	Female	5	152.5	1.63	150.0 - 154.3
	Male	4	167.1	3.27	163.2 - 170.9
Moscufo-Via Petrarca	Female	3	155.4	1.40	154.5 - 157.0
	Male	2	160.9	4.38	157.8 - 164.0
Spoltore-Quagliera	Female	2	155.7	0.55	155.3 - 156.0
	Male	4	166.3	1.34	164.5 - 167.7
Total	Female	10	154.0	2.02	150.0 - 157.0
	Male	10	165.6	3.54	157.8 - 170.9

There was a statistically significant difference in stature between males and females ($t = -8.940$, $p = 0.000$, $n=20$). There was no significant difference between adolescent and adult individuals ($t = -0.151$, $p = 0.881$, $n=20$). The significance was not evaluated for each single cemetery due to the small sample size.

6.3.2 Body Mass (BM)

Table 6.8 shows the average values of estimated body mass (BM) of female and male individuals from Loreto Ap.-Cappuccini (N = 21), Moscufo-Via Petrarca (N = 9), and Spoltore-Quagliera cemeteries (N = 14). The total number of individuals with preserved femoral heads available for the observation was N = 44.

Table 6.8 Average values of estimated body mass of female and male individuals from the three cemeteries (N = number of individuals with preserved femoral heads).

Cemetery	**Sex**	**N**	**Body Mass mean (Kg)**	**Std. Deviation**	**Range (Kg)**
Loreto Ap.-Cappuccini	Female	10	58.1	2.49	53.6 - 61.0
	Male	10	72.1	5.18	64.2 - 82.4
	Ambiguous	1	52.1	_	_
Moscufo-Via Petrarca	Female	4	59.7	2.15	57.8 - 61.6
	Male	5	59.9	6.52	51.7 - 66.7
Spoltore-Quagliera	Female	4	61.2	5.36	57.1 - 68.9
	Male	10	68.1	5.62	56.0 - 76.2
Total	Female	18	59.1	3.30	53.6 - 68.9
	Male	25	68.1	7.06	51.7 - 82.4
	Ambiguous	1	52.1	_	_

Results showed that the BM, considering the total pooled sample, differed by circa 9 kg between female and male individuals with males having a BM higher (68.1 Kg) than females (59.1 Kg). The Loreto Ap.-Cappuccini population showed the greatest difference between the sexes with males being 14.0 Kg heavier than females (Table 6.8), The mean BM between the sexes in Moscufo-Via Petrarca was fundamentally the same, while in Spoltore-Quagliera there was a difference of 6.9 Kg between female and male individuals. Analyses were carried out to check whether the difference between the BM means between the sexes was statistically significant. Tests were run on the BM means calculated on the pooled sample (N = 43). The individual with ambiguous sex was not included in the statistical analyses. Shapiro-Wilk test showed that the mean values are normally distributed for male individuals ($p = 0.341$) but not for females ($p = 0.043$). A nonparametric test for independent samples Mann-Whitney U Test was carried out to examine whether there was a difference in BM between female and male individuals. There is evidence to suggest that the difference in BM between female and male individuals was statistically significant (U = 381.000, p = 0.000). When age is considered, nonparametric test showed that the distribution of BM is the same across categories of age (H = 4.363, p = 0.225).

Whether or not there was a relationship between stature and BM was tested on individuals with known sex, stature and BM (N = 20). The results showed a strong positive correlation between stature and BM (Pearson correlation R2 = 0.752, p = 0.000), and BM increased as stature increased (Figure 6.3).

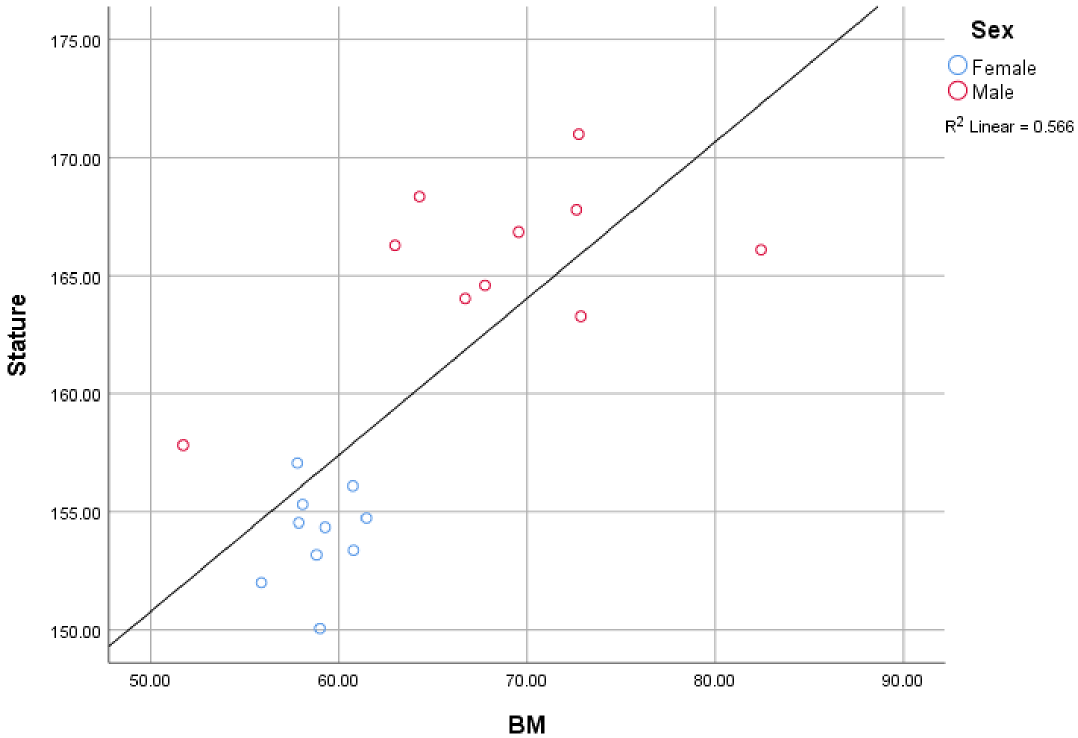

Figure 6.3 Scatterplot correlation between BM and stature.

6.4 Oral Health

6.4.1 Carious Lesions

The distribution of carious lesions across Loreto Ap.-Cappuccini, Moscufo-via Petrarca, and Spoltore-Quagliera cemeteries is presented in Table 6.9. Individuals with one or more teeth suitable for caries observation were included in the analysis (N= 33 Loreto Ap.-Cappuccini; N=13 Moscufo-via Petrarca; N=30 Spoltore-Quagliera). Within the pooled sample, 76 individuals met these conditions. Of these, 10 were immatures and 43 were adults, while 30 were female and 34 were males. True prevalence rate (TPR) of caries for the total combined sample was 69.7%. The TPR for immatures and adults was 45.5% and 79.6% respectively, while for female and male individuals was 83.3% and 70.6% respectively. The difference in prevalence of caries observed in immature and adult individuals was statistically significant (χ^2 = 8.651; p = 0.003). In contrast, the prevalence of caries in female and male individuals was not statistically significant (χ^2 = 1.443; p = 0.230).

Results show that caries were very common within the sample (Table 6.9). Loreto Ap.-Cappuccini showed the highest prevalence of individuals affected by carious lesions (78.8%), followed by Moscufo-Via Petrarca (69.2%). Spoltore-Quagliera presented the lowest prevalence rate (60.0%). Differences in prevalence of caries within each age group across cemeteries was evident in the young adult age category (Figure 6.4), showing an increase of 50.0% of cases in Loreto Ap.-Cappuccini compared to Moscufo-Via Petrarca, and 45.5% increase compared to Spoltore-Quagliera. Adults at Loreto Ap.-Cappuccini had significantly higher TPR than immatures (χ^2 = 12.916, p = 0.000), while no significant differences were observed at Moscufo-Via Petrarca (χ^2 = 1.003, p = 0.317) and Spoltore-Quagliera (χ^2 = 0.455, p = 0.500). There was not a statistically significant difference between females and males across cemeteries (χ^2=1.443, p = 0.230) (Figure 6.5). The number of female and male individuals with carious lesions within each cemetery is fundamentally the same and the difference in the TPR for caries between sexes remains not statistically significant (Loreto Ap.-Cappuccini: χ^2 = 0.294, p = 0.588; Moscufo-Via Petrarca: χ^2 = 2.037, p = 0.154; Spoltore-Quagliera: χ^2 = 1.050, p = 0.306).

The severity of caries was calculated quantifying the number of affected teeth (severity 1 = 1 tooth affected; severity 2 = 2 teeth affected; severity 3 = 3 teeth affected; severity 4+ = 4 or more teeth affected). Severity was analysed for each age (Table 6.10, Figure 6.6) and sex (Table 6.11, Figure 6.7) category, across the cemeteries. A high prevalence of individuals with four or more teeth affected by carious lesions was observed in the adult sample at Loreto Ap.-Cappuccini (65.2%) and Moscufo-Via Petrarca (55.5%). The adult population at Spoltore-Quagliera were less affected by caries compared to the others, and those affected were exhibiting the lesion on only two teeth. Juveniles were mildly affected in all the three cemeteries. When severity was analysed between the sexes (Table 6.11, Figure 6.7), both females and males at Loreto Ap.-Cappuccini showed the greatest severity, with four or more teeth affected. While at Spoltore-Quagliera, a high prevalence of females and males exhibited mild severity, with two teeth affected.

Table 6.9 True prevalence rate of caries for each age and sex category across cemeteries.

Age category		Loreto Ap.-Cappuccini					Moscufo-Via Petrarca				Spoltore-Quagliera				TOTAL
		Female	Male	Ambiguous	Unsexed	Total	Female	Male	Unsexed	Total	Female	Male	Unsexed	Total	
Infant	n/N	–	–	–	0/1	0/1	–	–	–	–	–	–		–	0/1
	%	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0
Children	n/N	–	–	–	1/4	1/4	–	–	–	–	–	–	–	–	1/4
	%	–	–	–	25.0	25.0	–	–	–	–	–	–	–	–	25.0
Juveniles	n/N	1/3	1/1	1/1	0/0	3/5	2/2	0/1	0/1	2/4	1/1	3/5	0/2	4/8	9/17
	%	33.3	100.0	100.0	0.0	60.0	100.0	0.0	0.0	50.0	100.0	60.0	0.0	50.0	52.9
Young adults	n/N	3/3	6/6	0/0	2/2	11/11	1/1	1/2	0/1	2/4	3/4	3/7	0/0	6/11	19/26
	%	100.0	100.0	0.0	100.0	100.0	100.0	50.0	0.0	50.0	75.0	42.8	0.0	54.5	73.1
Middle adults	n/N	3/3	3/4	0/0	0/0	6/7	1/1	1/1	0/0	2/2	3/3	3/4	0/0	6/7	14/16
	%	100.0	75.0	0.0	0.0	85.7	100.0	100.0	0.0	100.0	100.0	75.0	0.0	85.7	87.5
Old adults	n/N	4/4	1/1	0/0	0/0	5/5	1/1	2/2	0/0	3/3	2/4	0/0	0/0	2/4	10/12
	%	100.0	100.0	0.0	0.0	100.0	100.0	100.0	0.0	100.0	50.0	0.0	0.0	50.0	83.3
TOTAL	n/N	11/13	11/12	1/1	3/7	**26/33**	5/5	4/6	0/2	**9/13**	9/12	9/16	0/2	**18/30**	**53/76**
	%	84.6	91.6	100.0	42.9	**78.8**	100.0	66.6	0.0	**69.2**	75.0	56.2	0.0	**60.0**	**69.7**

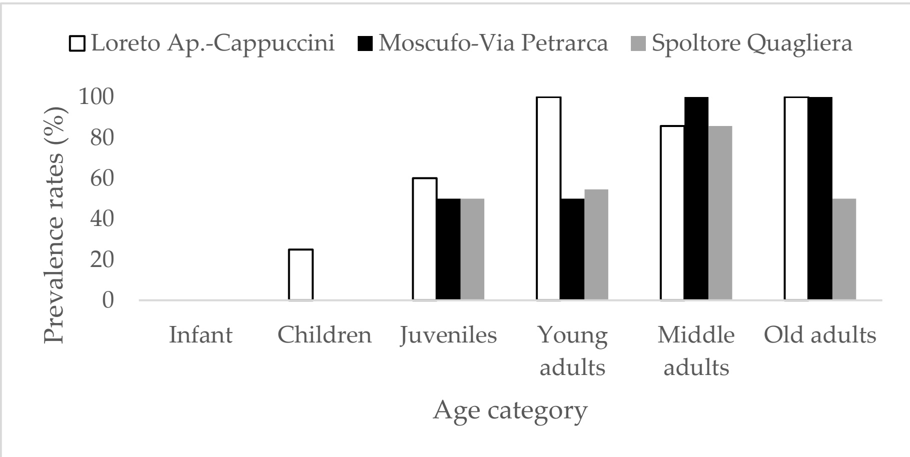

Figure 6.4 Prevalence rates in percentages of caries for each age category across cemeteries.

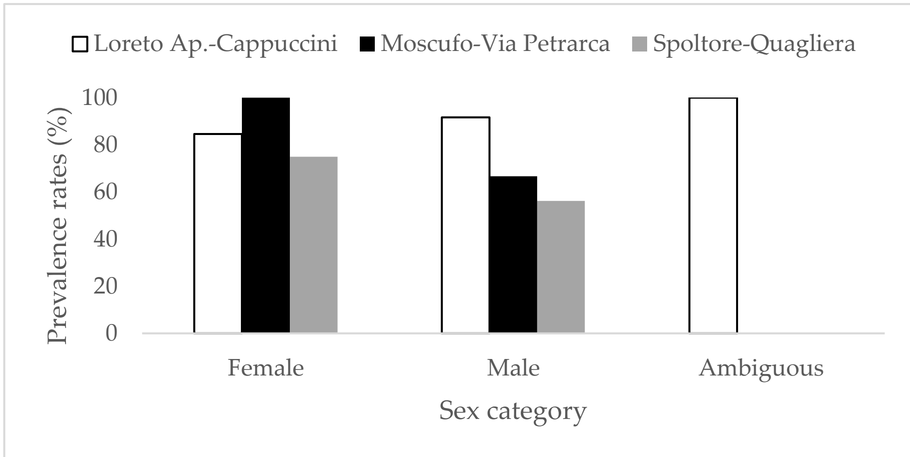

Figure 6.5 Prevalence rates in percentages of caries for each sex category across cemeteries.

Table 6.10 Prevalence and severity in percentages of dental caries for each age category across cemeteries (Severity 1 = 1 tooth affected; severity 2 = 2 teeth affected; severity 3 = 3 teeth affected; severity 4+ = 4 or more teeth affected).

Cemetery	**Age category**		**No caries**	**Severity**				**Total**
				1	2	3	4+	
Loreto Ap.-Cappuccini	Children	n	3	_	1	0	0	4
		%	75.0	_	25.0	0.0	0.0	100
	Juveniles	n	2	_	2	0	1	5
		%	40.0	_	40.0	0.0	20.0	100.0
	Adults	n	1	_	3	4	15	23
		%	4.3	_	13.0	17.4	65.2	100.00
Moscufo-Via Petrarca	Juveniles	n	2	2	0	_	0	4
		%	50.0	50.0	0.0	_	0.0	100.0
	Adults	n	2	0	2	_	5	9
		%	22.2	0.0	22.2	_	55.5	100.00
Spoltore-Quagliera	Juveniles	n	4	0	3	0	1	8
		%	50.0	0.0	37.5	0.0	12.5	100.0
	Adults	n	8	3	6	1	4	22
		%	36.4	13.6	27.3	4.5	18.2	100.0

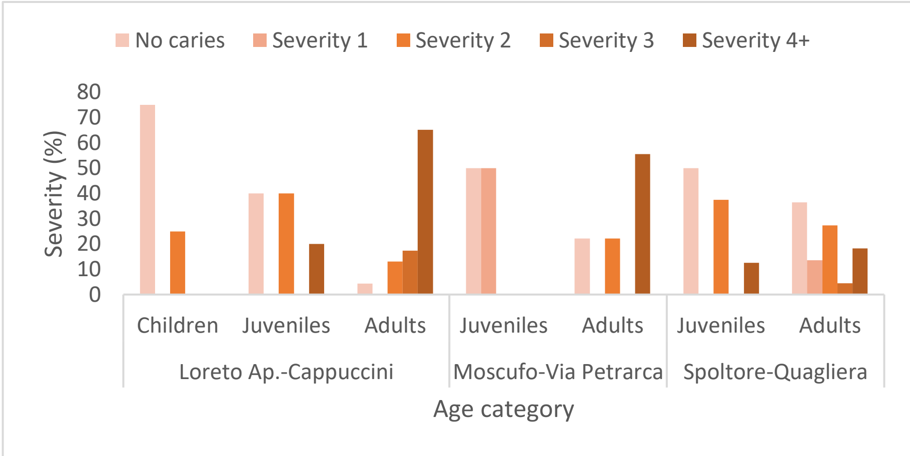

Figure 6.6 Prevalence and severity in percentages of dental caries for each age category across cemeteries (Severity 1 = 1 tooth affected; severity 2 = 2 teeth affected; severity 3 = 3 teeth affected; severity 4+ = 4 or more teeth affected).

Table 6.11 Prevalence and severity in percentages of dental caries for each sex category across cemeteries (Severity 1 = 1 tooth affected; severity 2 = 2 teeth affected; severity 3 = 3 teeth affected; severity 4+ = 4 or more teeth affected).

Cemetery	**Sex**		**No caries**	**Severity**				**Total**
				1	2	3	4+	
Loreto Ap.-Cappuccini	Female	n	2	_	1	2	8	13
		%	15.4	_	7.7	15.4	61.5	100.0
	Male	n	1	_	2	1	8	12
		%	8.3	_	16.7	8.3	66.7	100.00
Moscufo-Via Petrarca	Female	n	0	2	1	_	2	5
		%	0.0	40.0	20.0	_	40.0	100.0
	Male	n	2	0	1	_	3	6
		%	33.3	0.0	16.7	_	50.00	100.00
Spoltore-Quagliera	Female	n	3	2	5	0	2	12
		%	25.0	16.7	41.7	0.0	16.7	100.0
	Male	n	7	1	4	1	3	16
		%	43.8	6.3	25.0	6.3	18.8	100.0

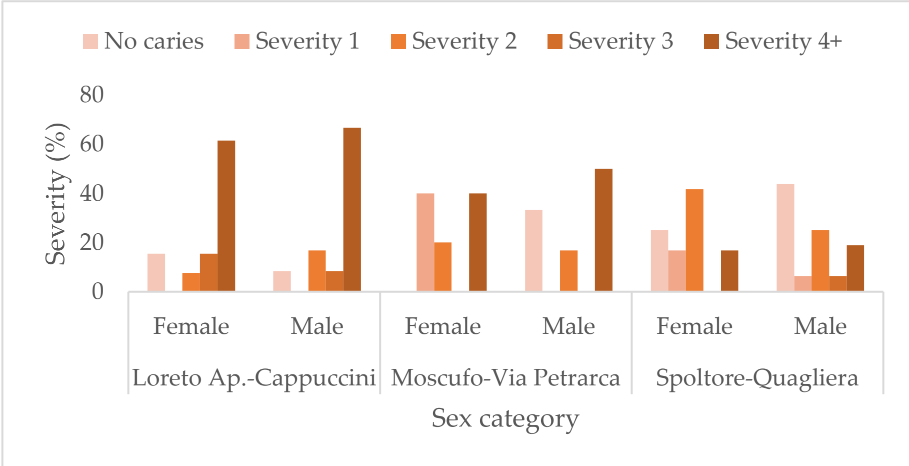

Figure 6.7 Prevalence and severity in percentages of dental caries for each sex category across cemeteries (Severity 1 = 1 tooth affected; severity 2 = 2 teeth affected; severity 3 = 3 teeth affected; severity 4+ = 4 or more teeth affected).

6.4.1 Periapical Lesions

Periapical lesions were recorded on individuals with at least maxilla or mandible bone present (N = 70; Loreto Ap.-Cappuccini N = 28; Moscufo-Via Petrarca N = 12; Spoltore-Quagliera N = 30). Of these, 17 were immatures and 53 were adults, and 30 were female and 34 males (Table 6.12). The TPR for periapical lesions of the totality of the individuals was 28.6%. The TPR for all the juveniles and adults were 11.8% and 33.9% respectively, while for female and male individuals was 20.1% and 38.2%, respectively. There was no statistically significant difference between juveniles and adults for the pooled sample ($\chi^2 = 3.108$; $p = 0.078$). There was no significant difference between female and male individuals ($\chi^2 = 2.539$; $p = 0.111$). The population of Loreto Ap.-Cappuccini showed the highest prevalence of periapical lesions (35.7%), while the one from Spoltore-Quagliera presented the lowest (23.3%). Periapical lesions prevalence increased as age increased as visible in Figure 6.8. Although, a slight decrease in the prevalence of periapical lesions was observed within the old age category in the Loreto Ap.-Cappuccini cemetery. At Moscufo-Via Petrarca periapical lesions were observed in the young adult (33.3%) and old adult (66.7%) age categories. Figure 6.9 shows the prevalence rates in percentages of periapical lesions for each sex category across cemeteries. Male individuals in Loreto Ap.-Cappuccini showed higher prevalence of periapical lesions (58.3%) compared to Moscufo-Via Petrarca (50.0%) and Spoltore-Quagliera (18.8%). In contrast, female individuals from Spoltore-Quagliera (33.3%) exhibited higher prevalence rate compared to Loreto Ap.-Cappuccini (15.4%). The severity was calculated based on the number of periapical lesions possessed by each individual.

Severity was analysed for each age (Table 6.13, Figure 6.10) and sex (Table 6.14, Figure 6.11) category, across the cemeteries. Most of the juveniles did not show periapical lesions, and those affected were mildly so. None of the juveniles at Moscufo-Via Petrarca presented the lesions. The severity of cases of periapical lesions was greater among the adults, however only three individuals at Loreto Ap.-Cappuccini exhibited three teeth with periapical lesions (13.0%) and only one adult at Spoltore-Quagliera had four or more teeth affected (4.5%). The remaining adults showed mild severity. When sex is considered, males showed higher severity than females across the cemeteries.

Table 6.12 Prevalence rate in percentage of individuals with periapical lesions for the three cemeteries.

Age category		Loreto Ap.-Cappuccini					Moscufo-Via Petrarca				Spoltore-Quagliera				TOTAL
		Female	Male	Ambiguous	Unsexed	Total	Female	Male	Unsexed	Total	Female	Male	Unsexed	Total	
Juveniles	n/N	0/3	0/1	1/1	0/0	1/5	0/2	0/1	0/1	0/4	0/1	1/5	0/2	1/8	2/17
	%	0.0	0.0	100.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	12.5	11.8
Young adults	n/N	1/3	3/6	0/0	0/2	4/11	0/1	1/2	0/0	1/3	2/4	1/7	0/0	3/11	8/25
	%	33.3	50.0	0.0	0.0	36.4	0.0	50.0	0.0	33.3	50.0	14.3	0.0	27.3	32.0
Middle adults	n/N	0/3	3/4	0/0	0/0	3/7	0/1	0/1	0/0	0/2	2/3	1/4	0/0	3/7	6/16
	%	0.0	75.0	0.0	0.0	42.9	0.0	0.0	0.0	0.0	66.7	25.0	0.0	42.9	37.5
Old adults	n/N	1/4	1/1	0/0	0/0	2/5	0/1	2/2	0/0	2/3	0/4	0/0	0/0	0/4	4/12
	%	25.0	100.0	0.0	0.0	40.0	0.0	100.0	0.0	66.7	0.0	0.0	0.0	0.0	33.3
TOTAL	n/N	2/13	7/12	1/1	0/2	**10/28**	0/5	3/6	0/1	**3/12**	4/12	3/16	0/2	**7/30**	**20/70**
	%	15.4	58.3	100.0	0.0	**35.7**	0.0	50.0	0.0	**25.0**	33.3	18.8	0.0	**23.3**	**28.6**

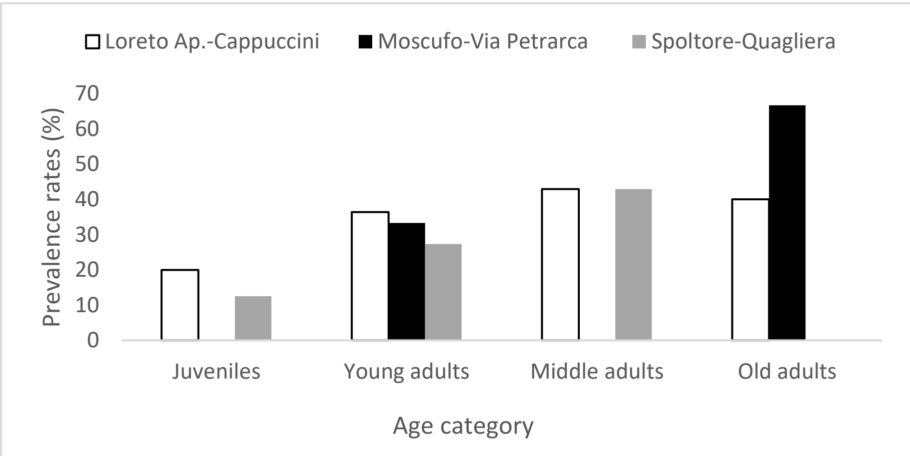

Figure 6.8 Prevalence rates in percentages of periapical lesions for each age category across cemeteries.

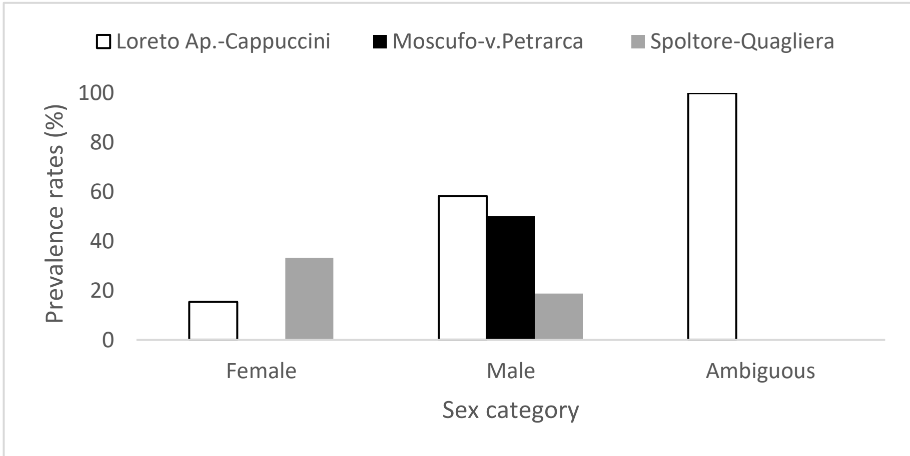

Figure 6.9 Prevalence rates in percentages of periapical lesions for each sex category across cemeteries.

Table 6.13 Prevalence and severity in percentages of periapical lesions for each sex category across cemeteries (Severity 1 = 1 tooth affected; severity 2 = 2 teeth affected; severity 3 = 3 teeth affected; severity 4+ = 4 or more teeth affected).

Cemetery	**Age category**		**No periapical lesions**	**Severity**				**Total**
				1	2	3	4+	
Loreto Ap.-Cappuccini	Juveniles	n	4	1	0	0	_	5
		%	80.0	20.0	0.0	0.0	_	100.0
	Adults	n	14	5	1	3	_	23
		%	60.8	21.7	4.3	13.0	_	100.00
Moscufo-Via Petrarca	Juveniles	n	4	0	0	_	_	4
		%	100.0	0.0	0.0	_	_	100.0
	Adults	n	5	1	2	_	_	8
		%	62.5	12.5	25.0	_	_	100.00
Spoltore-Quagliera	Juveniles	n	7	0	0	1	0	8
		%	87.5	0.0	0.0	12.5	0.0	100.0
	Adults	n	16	4	1	0	1	22
		%	72.7	18.2	4.5	0.0	4.5	100.0

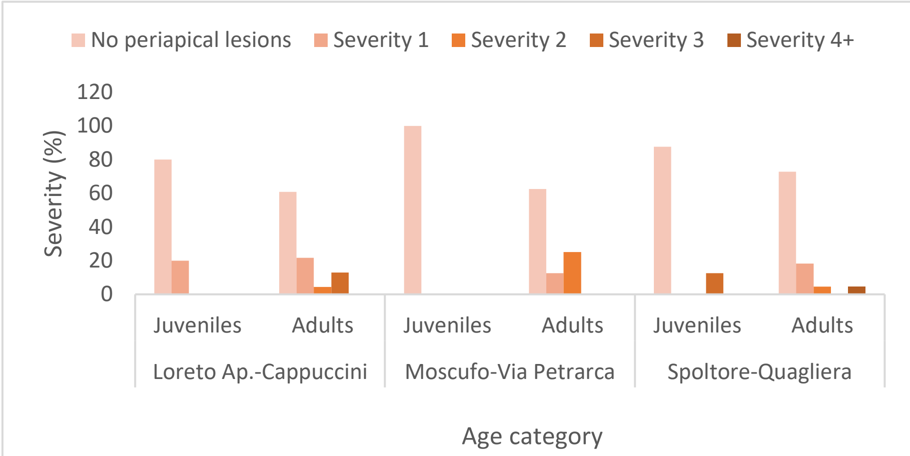

Figure 6.10 Prevalence and severity in percentages of periapical lesions for each sex category across cemeteries (Severity 1 = 1 tooth affected; severity 2 = 2 teeth affected; severity 3 = 3 teeth affected; severity 4+ = 4 or more teeth affected).

Table 6.14 Prevalence and severity in percentages of periapical lesions for each sex category across cemeteries (Severity 1 = 1 tooth affected; severity 2 = 2 teeth affected; severity 3 = 3 teeth affected; severity 4+ = 4 or more teeth affected).

Cemetery	**Sex category**		**No periapical lesions**	**Severity**				**Total**
				1	2	3	4+	
Loreto Ap.-Cappuccini	Female	n	11	2	0	0	–	13
		%	84.6	15.4	0.0	0.0	–	100.0
	Male	n	5	3	1	3	–	12
		%	41.7	25.0	8.3	25.0	–	100.00
Moscufo-Via Petrarca	Female	n	5	0	0	–	–	5
		%	100.0	0.0	0.0	–	–	100.0
	Male	n	3	1	2	–	–	6
		%	50	16.7	33.3	–	–	100.00
Spoltore-Quagliera	Female	n	8	3	1	0	0	12
		%	66.7	25.0	8.3	0.0	0.0	100.0
	Male	n	13	1	0	1	1	16
		%	81.3	6.3	0.0	6.3	6.3	100.0

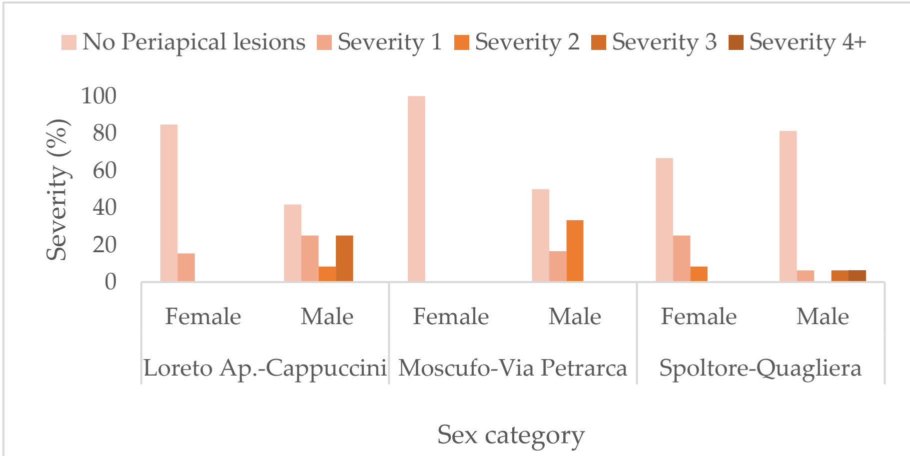

Figure 6.11 Prevalence and severity in percentages of periapical lesions for each sex category across cemeteries (Severity 1 = 1 tooth affected; severity 2 = 2 teeth affected; severity 3 = 3 teeth affected; severity 4+ = 4 or more teeth affected).

6.4.2 Dental Calculus

A total of 76 individuals possessed one or more teeth suitable for dental calculus observation (N = 33 Loreto Ap.-Cappuccini; N = 13 Moscufo-Via Petrarca; N = 30 Spoltore-Quagliera). Of these, 22 were immatures and 54 were adults, while 30 were females and 34 were males. The TPR of dental calculus for the pooled sample was 65.8% (Table 6.15). The TPR of calculus for immature and adult individuals was 45.5% and 74.1%, respectively with the difference in prevalence of calculus between the two not statistically significant ($\chi^2 = 1.184$; $p = 0.277$). The TPR of calculus for females and males was 63.3% and 82.35%, respectively: males exhibited higher prevalence of calculus than females. However, the difference was not statistically significant ($\chi^2 = 2.956$; $p = 0.086$). When examined at the cemetery level, the highest prevalence of dental calculus was observed in Spoltore-Quagliera (73.3%).

Figure 6.12 shows that dental calculus does not increase as age increases. Juvenile and middle adult individuals from Spoltore-Quagliera exhibited slightly higher prevalence of dental calculus compared to Loreto Ap.-Cappuccini. In contrast, young and old adults at Loreto Ap.-Cappuccini exhibited higher prevalence of dental calculus compared to the other two cemeteries. This difference is, however, not statistically significant. Within the sex category (Figure 6.13), female and male individuals from Loreto Ap.-Cappuccini showed higher prevalence of dental calculus compared to males and females at Moscufo-Via Petrarca and Spoltore-Quagliera. All middle adult females and males at Moscufo-Via Petrarca and Spoltore-Quagliera exhibited dental calculus, while at Loreto Ap.-Cappuccini calculus was common among young adult females and males.

The severity of calculus was considered based on the amount of calculus present in each tooth, and then the average was calculated for each individual. Severity was analysed for each age (Table 6.16, Figure 6.14) and sex (Table 6.17, Figure 6.15) category, across the cemeteries. The majority of juveniles and adults were exhibiting thin deposits. The highest prevalence of severity grade 2 was observed among the adult individuals from Spoltore-Quagliera (18%). Severity grade 3 (very noticeable thickness) was observed only in two adults from Spoltore-Quagliera. There was no presence of very thick deposits across the studied cemeteries. When sex is considered, males showed a higher prevalence of severity grade 2 compared to females across the cemeteries. Severity grade 3 was observed in two males from Spoltore-Quagliera.

Table 6.15 Prevalence rates of dental calculus for each age and sex category across cemeteries.

Age category		**Loreto Ap.-Cappuccini**					**Moscufo-Via Petrarca**				**Spoltore-Quagliera**				**TOTAL**
		Female	Male	Ambiguous	Unsexed	Total	Female	Male	Unsexed	Total	Female	Male	Unsexed	Total	
Infant	n/N	–	–	–	0/1	0/1	–	–	–	–	–	–	–	–	0/1
	%	–	–	–	0.0	0.0	–	–	–	–	–	–	–	–	0.0
Children	n/N	–	–	–	0/4	0/4	–	–	–	–	–	–	–	–	0/4
	%	–	–	–	0.0	0.0	–	–	–	–	–	–	–	–	0.0
Juveniles	n/N	1/3	1/1	0/1	0/0	2/5	1/2	0/1	1/1	2/4	1/1	4/5	1/2	6/8	10/17
	%	33.3	100.0	0.0	0.0	40.0	50.0	0.0	100.0	50.0	100.0	80.0	0.0	75.00	58.8
Young adults	n/N	3/3	6/6	0/0	1/2	10/11	0/1	1/2	0/1	1/4	2/4	6/7	0/0	8/11	19/26
	%	100.0	100.0	0.0	50.0	90.9	0.0	50.0	0.0	25.0	50.0	85.7	0.0	72.7	73.1
Middle adults	n/N	3/3	3/4	0/0	0/0	6/7	1/1	1/1	0/0	2/2	3/3	4/4	0/0	7/7	15/16
	%	100.0	75.0	0.0	0.0	85.7	100.0	100.0	0.0	100.0	100.0	100.0	0.0	100.0	93.7
Old adults	n/N	3/4	1/1	0/0	0/0	4/5	0/1	1/2	0/0	1/3	1/4	0/0	0/0	1/4	6/12
	%	75.0	100.0	0.0	0.0	80.0	0.0	50.0	0.0	33.3	25.0	0.0	0.0	25.0	50.0
TOTAL	n/N	10/13	11/12	0/1	1/7	**22/33**	2/5	3/6	1/2	**6/13**	7/12	14/16	1/2	**22/30**	**50/76**
	%	76.9	91.6	0.0	14.3	**66.6**	40.0	50.0	50.0	**46.2**	58.3	87.5	50.0	**73.3**	**65.8**

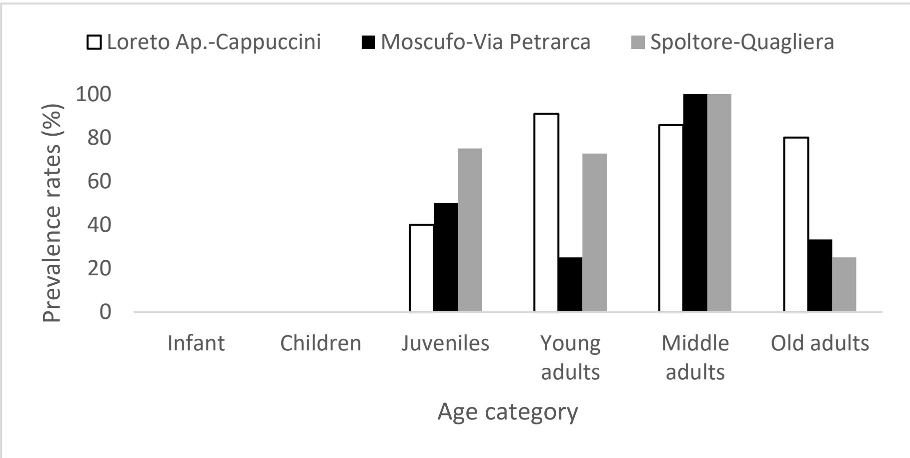

Figure 6.12 Prevalence rates in percentages of calculus for each age category across cemeteries.

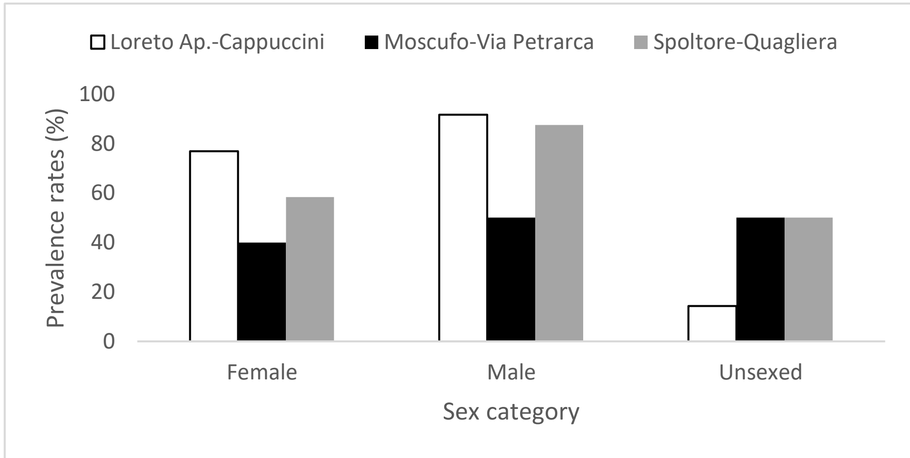

Figure 6.13 Prevalence rates in percentages of calculus for each sex category across cemeteries.

Table 6.16 Prevalence rates and severity in percentages of dental calculus for each age category across cemeteries (Grade 1 = thin deposit, Grade 2 = noticeable thickness, Grade 3 = very noticeable thickness, Grade 4 = very thick deposit).

Cemetery	**Age category**		**No calculus**	**Grade**				**Total**
				1	2	3	4	
Loreto Ap.-Cappuccini	Juveniles	n	3	2	0	_	_	5
		%	60.0	40.0	0.0	_	_	100.0
	Adults	n	3	18	2	_	_	23
		%	13	78.3	8.7	_	_	100.00
Moscufo-Via Petrarca	Juveniles	n	2	2	0	_	_	4
		%	50.0	50.0	0.0	_	_	100.0
	Adults	n	5	3	1	_	_	9
		%	55.6	33.3	11.1	_	_	100.00
Spoltore-Quagliera	Juveniles	n	3	4	1	0	_	8
		%	37.5	50.0	12.5	0.0	_	100.0
	Adults	n	6	10	4	2	_	22
		%	27.3	45.5	18.2	9.1	_	100.0

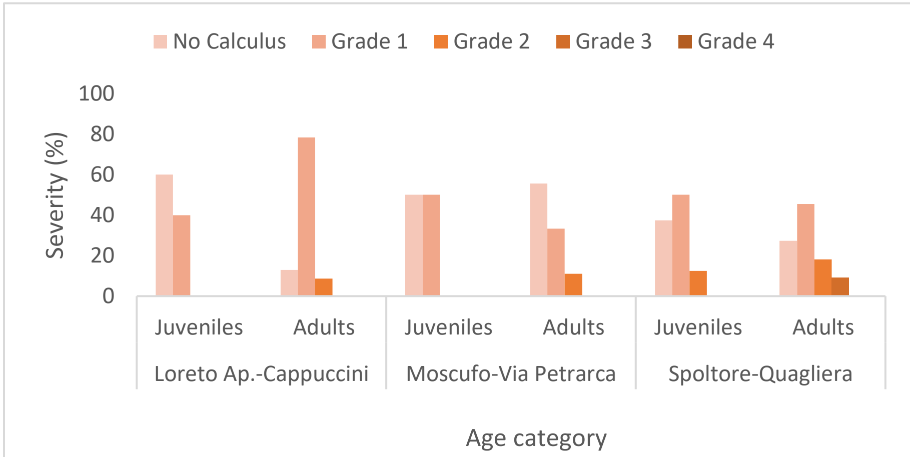

Figure 6.14 Prevalence rates and severity in percentages of dental calculus for each age category across cemeteries (Grade 1 = thin deposit, Grade 2 = noticeable thickness, Grade 3 = very noticeable thickness, Grade 4 = very thick deposit).

Table 6.17 Prevalence and severity in percentages of dental calculus for each sex category across cemeteries (Grade 1 = thin deposit, Grade 2 = noticeable thickness, Grade 3 = very noticeable thickness, Grade 4 = very thick deposit).

Cemetery	**Sex category**		**No calculus**	**Grade** 1	2	3	4	**Total**
Loreto Ap.-Cappuccini	Female	n	3	10	0	–	–	13
		%	23.1	76.9	0.0	–	–	100.0
	Male	n	1	9	2	–	–	12
		%	8.3	75.0	16.7	–	–	100.00
Moscufo-Via Petrarca	Female	n	3	2	0	–	–	5
		%	60.0	40.0	0.0	–	–	100.0
	Male	n	3	2	1	–	–	6
		%	50.0	33.3	16.7	–	–	100.0
Spoltore-Quagliera	Female	n	5	5	2	0	–	12
		%	41.7	41.7	16.7	0.0	–	100.0
	Male	n	2	9	3	2	–	16
		%	12.5	56.3	18.8	7.1	–	100.0

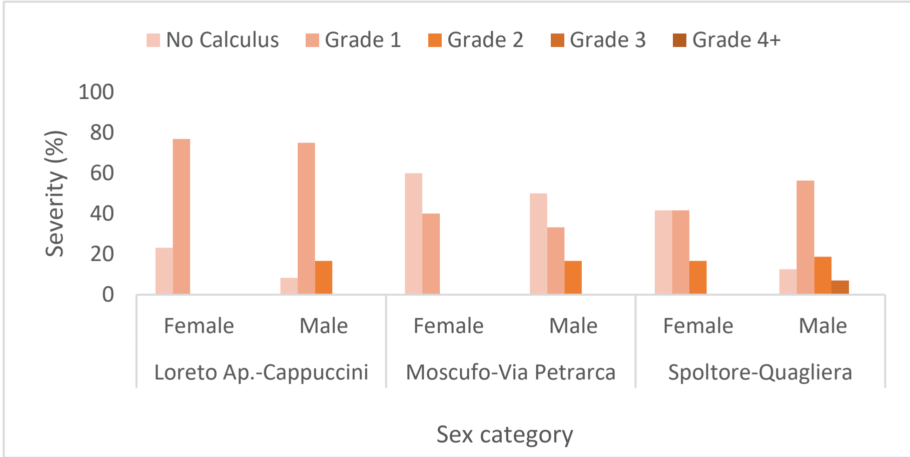

Figure 6.15 Prevalence and severity in percentages of dental calculus for each sex category across cemeteries (Grade 1 = thin deposit, Grade 2 = noticeable thickness, Grade 3 = very noticeable thickness, Grade 4 = very thick deposit).

6.4.3 Periodontitis

Periodontitis was recorded on individuals with at least one tooth present into the socket, or maxilla or mandible bone with suitable alveoli for recording. A total of N = 69 individuals met these conditions (Loreto Ap.-Cappuccini N = 28; Moscufo-Via Petrarca N = 12; Spoltore-Quagliera N = 29). Of these, 16 were juveniles and 53 were adults, while 29 were female and 34 were males. The TPR of periodontitis for the pooled sample was 79.7% (Table 6.18). The TPR for juveniles and adults was 41.2% and 92.3%, respectively. There was a significant difference in prevalence of periodontitis between the two categories ($\chi^2 = 20.710$; $p = 0.000$). The TPR for females and males was 75.0% and 88.6% respectively, and the difference was not significant. The highest prevalence of periodontitis was observed at Loreto Ap.-Cappuccini (89.3%), while the lowest at Spoltore-Quagliera (69.0%).

Figure 6.17 shows a high prevalence of periodontal disease across the cemeteries and within all ages. Periodontitis was already present in juveniles. At Spoltore-Quagliera the prevalence of periodontitis increases as age increases. In contrast, a sharp increase was observed between the juveniles and young adults at Loreto Ap.-Cappuccini and Moscufo-Via Petrarca, and the same prevalence rate was maintained from young to old adult age categories. When the sex category is considered, a few major differences could be observed (Figure 6.16). Females at Loreto Ap.-Cappuccini showed a slightly higher prevalence of periodontitis (84.6%) compared to the females from the two other cemeteries (Moscufo-Via Petrarca: females = 80.0%; Spoltore-Quagliera: females = 63.6%). Differently, male individuals from Moscufo-Via Petrarca (100.0%) and Loreto Ap.-Cappuccini (91.7%) exhibited higher prevalence compared to the males at Spoltore-Quagliera (81.3%). Within each cemetery, overall, prevalence was higher in males than females.

Severity was analysed for each age (Table 6.19, Figure 6.18) and sex (Table 6.20, Figure 6.19) category, across the cemeteries. Overall, adults across the cemeteries were severely affected by periodontal disease, and showed mild (grade 1), moderate (grade 2) and severe (grade 3) lesions. Only three adult individuals within each cemetery presented grade 3 of severity (Loreto Ap.-Cappuccini = 13.0%; Moscufo-Via Petrarca = 37.5%;

Spoltore-Quagliera = 14.3%). When sex is considered, there was little variation in severity of periodontal disease between female and males at Loreto Ap.-Cappuccini and Moscufo-Via Petrarca. Differences of periodontitis were more evident at Spoltore-Quagliera, where males showed higher prevalence of mild and moderate severity than females.

Table 6.18 Prevalence rates in percentages of periodontitis for each age and sex categories across cemeteries.

Age category		**Loreto Ap.-Cappuccini**					**Moscufo-Via Petrarca**				**Spoltore-Quagliera**				**TOTAL**
		Female	Male	Ambiguous	Unsexed	Total	Female	Male	Unsexed	Total	Female	Male	Unsexed	Total	
Juveniles	n/N	1/3	0/1	1/1	_	2/5	1/2	1/1	0/1	2/4	0/1	3/5	0/2	3/8	7/17
	%	33.3	_	100.0	_	40.0	50.0	100.0	0.0	50.2	0.0	60.0	0.0	37.5	41.2
Young adults	n/N	3/3	6/6	0/0	2/2	11/11	1/1	2/2	_	3/3	2/4	6/7	_	8/11	22/25
	%	100.0	100.0	_	100.0	100.0	100.0	100.0	_	100.0	50.0	85.7	_	72.7	88.0
Middle adults	n/N	3/3	4/4	_	_	7/7	1/1	1/1	_	2/2	2/3	4/4	_	6/7	15/16
	%	100.0	100.0	_	_	100	100.0	100.0	_	100.0	66.7	100.0	_	85.7	99.8
Old adults	n/N	4/4	1/1	_	_	5/5	1/1	2/2	_	3/3	3/3	_	_	3/3	11/11
	%	100.0	100.0	_	_	100.0	100.0	100.0	_	100.0	100.0	_	_	100.0	100.0
TOTAL	n/N	11/13	11/12	1/1	2/2	**25/28**	4/5	6/6	0/1	**10/12**	7/11	13/16	0/2	**20/29**	**55/69**
	%	84.6	91.7	100.0	100.0	**89.3**	80.0	100.0	0.0	**83.3**	63.6	81.3	0.0	**69.0**	**79.7**

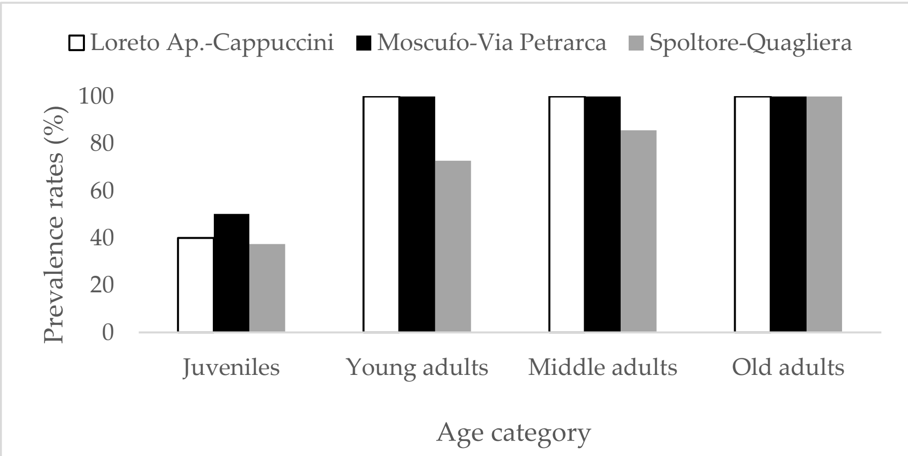

Figure 6.16 Prevalence rates in percentages of periodontitis for each age category across cemeteries.

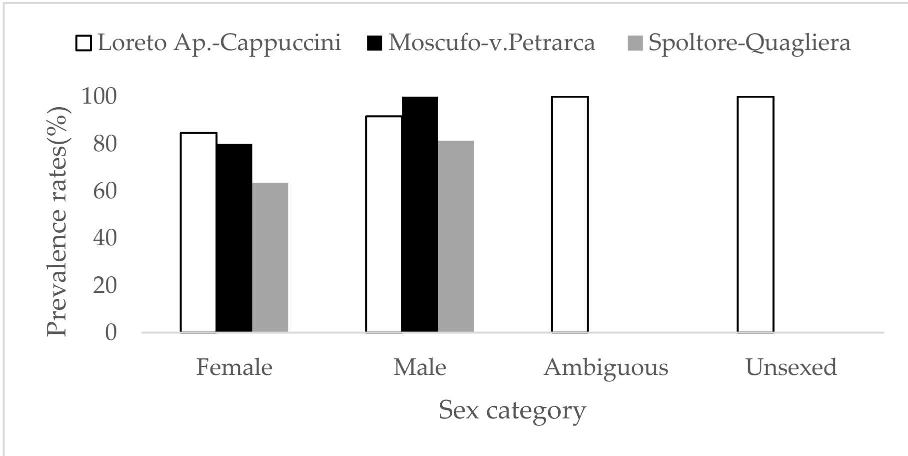

Figure 6.17 Prevalence rates in percentages of periodontitis for each sex category across cemeteries.

Table 6.19 Prevalence rates and severity in percentages of periodontitis for each age category across cemeteries (Grade 1 = 2-3 mm from cemento-enamel junction and alveolar margin, Grade 2 = 3-5 mm, Grade 3 = majority of tooth root exposed).

Cemetery	**Age category**		**No periodontitis**	**Grade**			**Total**
				1	2	3	
Loreto Ap.-Cappuccini	Juveniles	n	3	2	0	0	5
		%	60.0	40.0	0.0	0.0	100.0
	Adults	n	0	10	10	3	23
		%	0.0	43.5	43.5	13.0	100.00
Moscufo-Via Petrarca	Juveniles	n	2	2	0	0	4
		%	50.0	50.0	0.0	0	100.0
	Adults	n	0	3	2	3	8
		%	0.0	37.5	25.0	37.5	100.00
Spoltore-Quagliera	Juveniles	n	5	2	1	0	8
		%	62.5	25.0	12.5	0.0	100.0
	Adults	n	4	3	11	3	21
		%	19.0	14.3	52.4	14.3	100.0

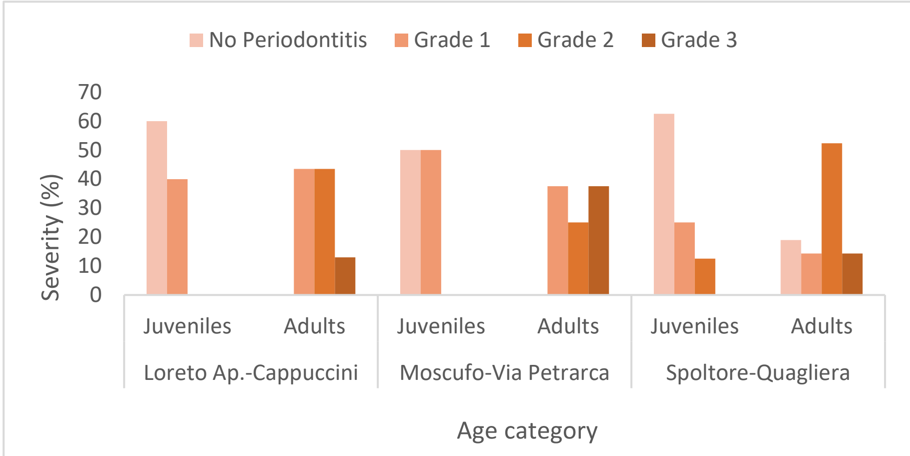

Figure 6.18 Prevalence rates and severity in percentages of periodontitis for each age category across cemeteries (Grade 1 = 2-3 mm from cemento-enamel junction and alveolar margin, Grade 2 = 3-5 mm, Grade 3 = majority of tooth root exposed).

Table 6.20 Prevalence rates and severity in percentages of periodontitis for each sex category across cemeteries (Grade 1 = 2-3 mm from cemento-enamel junction and alveolar margin, Grade 2 = 3-5 mm, Grade 3 = majority of tooth root exposed).

Cemetery	**Sex category**		**No periodontitis**	**Grade**			**Total**
				1	2	3	
Loreto Ap.-Cappuccini	Female	n	2	5	5	1	13
		%	15.4	38.5	38.5	7.7	100.0
	Male	n	1	6	4	1	12
		%	8.3	50.0	33.3	8.3	100.0
Moscufo-Via Petrarca	Female	n	1	1	1	1	4
		%	25.0	25.0	25.0	25.0	100.0
	Male	n	0	4	1	2	7
		%	0.0	57.1	14.3	28.6	100.0
Spoltore-Quagliera	Female	n	4	1	3	3	11
		%	36.4	9.1	27.3	27.3	100.0
	Male	n	3	4	9	0	16
		%	18.8	25.0	56.3	0.0	100.0

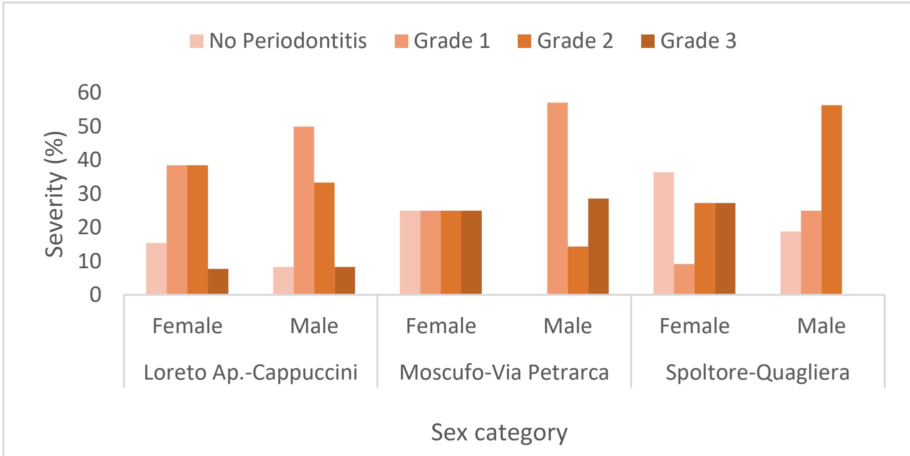

Figure 6.19 Prevalence rates and severity in percentages of periodontitis for each sex category across cemeteries (Grade 1 = 2-3 mm from cemento-enamel junction and alveolar margin, Grade 2 = 3-5 mm, Grade 3 = majority of tooth root exposed).

6.4.4 Dental Wear

Dental wear was observed on individuals from Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera with one or more teeth suitable for observation. Maxilla and mandibular bones were examined separately. Mean wear values were calculated and pooled to obtain the mean wear for each tooth type within each age category. Mean wears were also calculated for each single cemetery (Table 6.21, Table 6.22, Table 6.23). Dental wear was further analysed according to the number of teeth that exhibit the different grades of wear, and percentages were calculated for the total sample in each cemetery (Table 6.24, Figure 6.20).

There was no clear different pattern of dental wear between maxilla and mandibular teeth across the cemeteries, even though the prevalence of individuals exhibiting wear on maxillary teeth appeared slightly higher than the ones exhibiting wear on mandibular teeth. Marked differences were observed between anterior and posterior teeth, with anterior teeth being more worn than posterior ones. Young adults from the Loreto Ap-Cappuccini cemetery showed severely worn maxillary and mandibular incisors and canines (Mean wear maxilla: I1 = 6.3, I2 = 5.1, C = 4.9; Mean wear mandible: I1 = 5.6, I2 = 5.0, C = 4.8). With regards to the general prevalence of wear across the cemeteries, the individuals from Spoltore-Quagliera presented less worn teeth.

Dental wear was further analysed considering the total number of teeth of each cemetery (Table 6.24, Figure 6.20). Overall, the highest percentages of maxillary and mandibular teeth with wear grade 6, 7 and 8 was observed in Loreto Ap.-Cappuccini (maxilla: grade 6 = 9.0%, grade 7 = 10.0%, and grade 8 = 3.7%; mandible: grade 6 = 12.1%, grade 7 = 4.5%, and grade 8 = 3.9%).

Table 6.21 Average dental wear of the maxillary and mandibular teeth of individuals from Loreto Ap.-Cappuccini cemetery (left and right side pooled, n = number of individuals with tooth type preserved).

Age category		**Loreto Ap.-Cappuccini**															
		Maxilla								**Mandible**							
		I1	I2	C	P1	P2	M1	M2	M3	I1	I2	C	P1	P2	M1	M2	M3
Immatures	n	1	1	0	0	0	5	2	0	1	1	0	0	0	5	1	0
	average-wear	0.2	0	0	0	0	1.0	0.4	0.0	0.2	0	0	0	0	1.0	0.2	0.0
Juveniles	n	4	4	5	5	5	4	4	3	3	4	5	5	5	5	5	4
	average-wear	3.5	3	3	2.3	2	2.4	1.5	0.8	2.4	3	3	2.4	3	3.5	2.0	1.0
Young adults	n	6	8	9	11	10	11	9	6	5	8	10	9	10	9	10	8
	average-wear	6.3	5.1	4.9	4	4	4.8	3.9	2.8	5.6	5.0	4.8	3.8	4.1	5.0	4.0	2.9
Middle adults	n	3	5	5	7	6	7	5	4	5	6	6	7	7	6	6	6
	average-wear	5.8	5.2	5.1	5.2	5.0	5.6	5.5	6.4	5.5	4.6	4.5	4.2	4.4	6.1	5.3	5.3
Old adults	n	3	3	4	3	4	5	2	2	3	5	4	4	5	3	2	1
	average-wear	6.3	4.8	4.9	5.5	4.9	5.5	4.0	3.0	5.8	5.2	4.6	5	5.3	7.5	7.0	5.0
Total	n	17	21	23	26	25	32	22	15	17	24	25	25	27	28	24	19
	average-wear	4.4	4.6	4.5	4.2	4.0	4.3	3.7	3.5	5.1	4.5	4.3	3.8	4.1	4.6	4.0	3.6

Table 6.22 Average dental wear of the maxillary and mandibular teeth of individuals from Moscufo-Via Petrarca cemetery (left and right side pooled, n = number of individuals with tooth type preserved).

Age category		**Moscufo-Via Petrarca**															
		Maxilla								**Mandible**							
		I1	I2	C	P1	P2	M1	M2	M3	I1	I2	C	P1	P2	M1	M2	M3
Juveniles	n	2	2	2	2	0	3	3	0	3	4	4	3	3	4	4	2
	average-wear	3.5	3.0	3.0	1.8	0.0	2.5	2.0	0.0	3.0	2.4	2.1	1.7	1.7	2.9	2.3	1.3
Young adults	n	2	1	1	2	1	3	3	2	1	1	2	2	2	3	4	1
	average-wear	5.0	3.5	3.5	4.5	3.0	4.8	2.8	1.5	4.0	3.5	3.8	4.0	3.0	4.7	3.8	2.0
Middle adults	n	1	2	1	1	0	0	1	1	1	2	2	2	2	2	2	0
	average-wear	4.0	4.5	5.0	3.0	0.0	0.0	3.0	2.0	5.0	4.8	3.8	3.3	3.5	6.8	6.0	0.0
Old adults	n	3	1	2	1	0	0	0	0	3	2	3	3	2	1	1	1
	average-wear	6.7	7.0	5.5	4	0.0	0.0	0.0	0.0	5.5	5.5	4.5	4.3	5.0	6.0	8.0	7.0
Total	n	8	6	6	6	1	6	7	3	8	9	11	10	9	10	11	4
	mean-wear	5.1	4.3	4.3	3.3	3.0	3.7	2.5	1.7	4.3	3.7	3.4	3.3	3.1	4.5	4.0	2.9

Table 6.23 Average dental wear of the maxillary and mandibular teeth of individuals from Spoltore-Quagliera cemetery (left and right side pooled, n = number of individuals with tooth type preserved).

Age category		**Spoltore-Quagliera**															
		Maxilla								**Mandible**							
		I1	I2	C	P1	P2	M1	M2	M3	I1	I2	C	P1	P2	M1	M2	M3
Juveniles	n	7	8	8	8	7	8	8	5	8	8	8	8	8	8	8	6
	average-wear	3.5	2.8	2.7	2.4	2.4	2.9	2.3	2.4	3.2	3.1	2.8	2.2	1.9	3.0	2.4	1.8
Young adults	n	10	10	10	10	10	10	10	7	11	11	11	11	11	11	10	7
	average-wear	5.0	4.5	4.3	3.7	3.4	4.2	3.4	2.3	4.8	4.4	4.0	3.2	3.1	4.5	3.4	2.9
Middle adults	n	6	6	7	7	7	7	5	3	6	6	6	7	7	6	7	5
	average-wear	5.8	5.2	5.4	5.4	4.9	5.9	4.5	3.3	4.8	4.6	4.3	3.7	4.6	5.1	5.4	3.2
Old adults	n	1	1	1	1	0	0	1	0	0	0	2	2	2	0	1	1
	average-wear	6.0	5.0	5.0	5	0.0	0.0	4.0	0.0	0.0	0.0	6.5	5.5	6.0	0.0	8.0	8.0
Total	n	24	25	26	26	24	25	24	15	25	25	27	28	28	25	26	19
	average-wear	4.8	4.1	4.1	3.8	3.5	4.3	3.3	2.5	4.3	4.0	3.9	3.2	3.3	4.1	3.8	2.9

Table 6.24 Wear calculated on the number of teeth exhibiting different grades of severity across cemeteries.

Cemetery		**Maxilla**									**Mandible**								
		Wear									**Wear**								
		1	2	3	4	5	6	7	8	Total teeth count (N)	1	2	3	4	5	6	7	8	Total teeth count (N)
Loreto Ap.-Cappuccini	n	18	27	67	50	69	27	30	11	299	18	23	71	95	55	40	15	13	330
	%	6.0	9.0	22.4	16.7	23.1	9.0	10.0	3.7	100.0	5.5	7.0	21.5	28.8	16.7	12.1	4.5	3.9	100.0
Moscufo-Via Petrarca	n	1	13	20	14	11	3	2	2	66	10	25	29	22	13	5	3	3	120
	%	1.5	19.7	30.3	21.2	16.7	4.5	3.0	3.0	100.0	8.3	20.8	24.2	18.3	10.8	4.2	2.5	2.5	100.0
Spoltore-Quagliera	n	13	46	96	80	62	26	12	9	344	15	51	122	92	71	12	1	8	372
	%	3.8	13.4	27.9	23.3	18.0	7.6	3.5	2.6	100.0	4.0	13.7	32.8	24.7	19.1	3.2	0.3	2.2	100.0
Total	n	32	86	183	144	142	56	44	22	709	43	99	222	209	139	57	19	24	822
	%	4.5	12.1	25.8	20.3	20.0	7.9	6.2	3.1	100.0	5.2	12.0	27.0	25.4	16.9	6.9	2.3	2.9	100.0

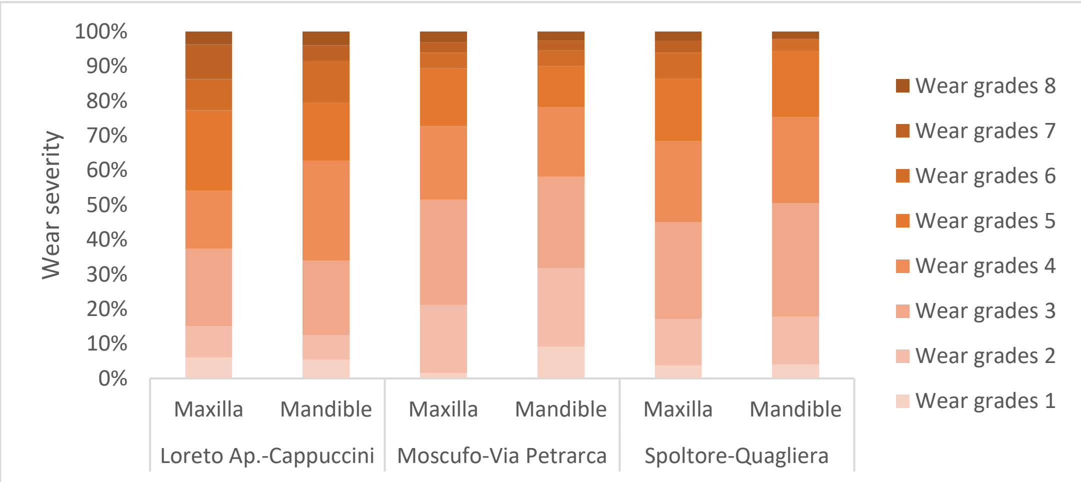

Figure 6.20 Percentages of wear severity calculated on the number of teeth, across cemeteries.

6.4.5 Antemortem Tooth Loss (AMTL)

A total of 70 individuals possessed one or more tooth sockets preserved and suitable for the analysis of AMTL (N = 28 Loreto Ap.-Cappuccini; N = 12 Moscufo-Via Petrarca; N = 30 Spoltore-Quagliera). Of these, 17 were juveniles and 53 were adults, while 30 were females and 34 were males. The TPR of AMTL exhibited by the pooled sample was 42.9% (Table 6.25). AMTL was not observed in the juvenile age category, while it was present in 56.6% of adults. Within the sex category, 56.7% of females and 35.3% males exhibited AMTL. Results showed that the difference in prevalence of AMTL between sexes was not statistically significant ($\chi^2 = 2.938$; $p = 0.087$). The highest prevalence of individuals with AMTL was observed in Loreto Ap.-Cappuccini (57.1%), however there was no statistically significant difference across the cemeteries ($\chi^2 = 4.365$; $p = 0.113$).

Overall it was observed a low prevalence of AMTL, however Figure 6.22 shows that the prevalence of AMTL increases as age increases. Middle and old adults were the most affected across the cemeteries, in particular at, Loreto Ap.-Cappuccini (middle adults = 100.0%, old adults = 100.0%) and Spoltore-Quagliera (middle adults = 71.4%, old adults = 100.0%). The prevalence rate of AMTL for each sex category is shown in Figure 6.22. There was no significant difference between the females and males at Loreto Ap.-Cappuccini and Moscufo-Via Petrarca. There was significant difference between the sexes at Spoltore-Quagliera ($\chi^2 = 6.601$; $p = 0.010$).

The severity of AMTL was calculated considering the number of teeth lost antemortem by single individual in each age (Table 6.26, Figure 6.23) and sex (Table 6.27, Figure 6.24) category. A high prevalence of adult individuals across the cemeteries, lost four or more teeth antemortem (Loreto Ap.-Cappuccini = 21.4%; Moscufo-Via Petrarca = 37.5%; Spoltore-Quagliera = 18.2%) (Figure 6.23). With regards to the sex categories, females appeared more affected than males by severe AMTL. However, this difference may be due to the small sample size.

Table 6.25 Prevalence rates in percentages of AMTL for each age and sex categories across cemeteries.

Age category		**Loreto Ap.-Cappuccini**					**Moscufo-Via Petrarca**				**Spoltore-Quagliera**				**TOTAL**
		Female	Male	Ambiguous	Unsexed	Total	Female	Male	Unsexed	Total	Female	Male	Unsexed	Total	
Juveniles	n/N	0/3	0/1	0/1	0/0	0/5	0/2	0/1	0/1	0/4	0/1	0/5	0/2	0/8	0/17
	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Young adults	n/N	1/3	2/6	0/0	1/2	4/11	0/1	0/2	0/0	0/3	2/4	0/7	0/0	2/11	6/25
	%	33.3	33.3	0.0	50.0	36.4	0.0	0.0	0.0	0.0	50.0	0.0	0.0	18.2	24.0
Middle adults	n/N	3/3	4/4	0/0	0/0	7/7	0/1	1/1	0/0	1/2	2/3	3/4	0/0	5/7	13/16
	%	100.0	100.0	0.0	0.0	100	0.0	100.0	0.0	50.0	66.6	75.0	0.0	71.4	81.3
Old adults	n/N	4/4	1/1	0/0	0/0	5/5	1/1	1/2	0/0	2/3	4/4	0/0	0/0	4/4	12/12
	%	100.0	100.0	0.0	0.0	100.0	100.0	50.0	0.0	66.7	100.0	0.0	0.0	100.0	100.0
TOTAL	n/N	8/13	7/12	0/1	1/2	**16/28**	1/5	2/6	0/1	**3/12**	8/12	3/16	0/2	**11/30**	**30/70**
	%	61.5	58.3	0.0	50.0	**57.1**	20.0	33.3	0.0	**25.0**	66.7	18.8	0.0	**36.6**	**42.9**

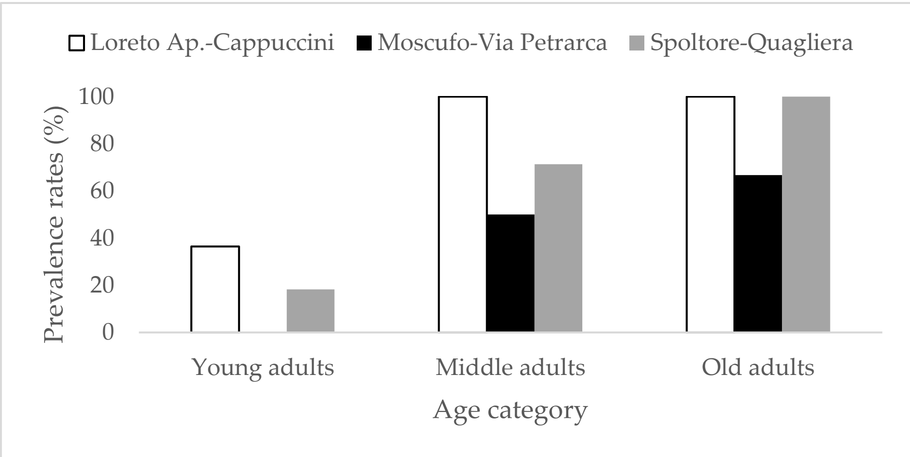

Figure 6.21 Prevalence rates in percentages of AMTL for each age category across cemeteries.

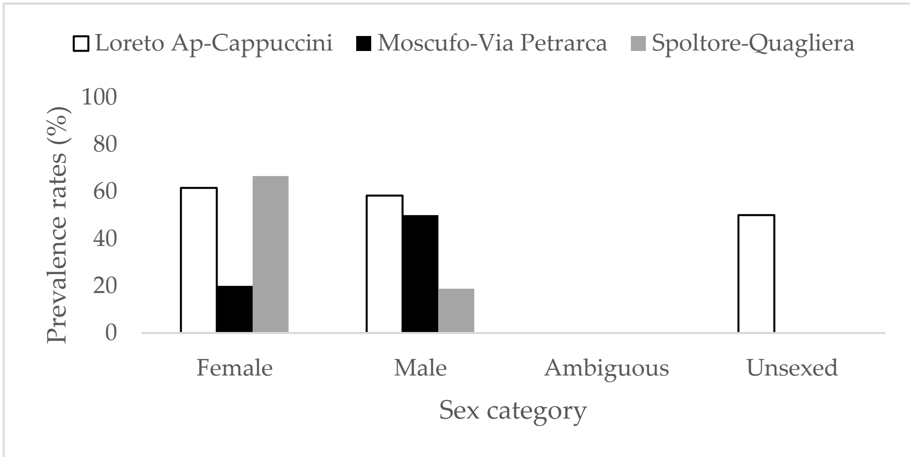

Figure 6.22 Prevalence rates in percentages of AMTL for each sex category across cemeteries.

Table 6.26 Prevalence of severity in percentages of AMTL for each age category across cemeteries (Severity 1 = 1 tooth lost ante-mortem; severity 2 = 2 teeth lost ante-mortem; severity 3 = 3 teeth lost ante-mortem; severity 4+ = 4 or more teeth lost ante-mortem).

Cemetery	**Age category**		**No AMTL**	**Severity**				**Total**
				1	2	3	4+	
Loreto Ap.-Cappuccini	Juveniles	n	5	0	0	0	0	5
		%	100.0	0.0	0.0	0.0	0.0	100.0
	Adults	n	7	4	1	5	6	28
		%	25.0	14.3	3.6	17.9	21.4	100.00
Moscufo-Via Petrarca	Juveniles	n	4	–	–	–	0	4
		%	100.0	–	–	–	0.0	100.0
	Adults	n	5	–	–	–	3	8
		%	62.5	–	–	–	37.50	100.00
Spoltore-Quagliera	Juveniles	n	8	0	0	0	0	8
		%	100.0	0.0	0.0	0.0	0.0	100.0
	Adults	n	11	2	3	2	4	22
		%	50.0	9.1	12.6	9.1	18.2	100.0

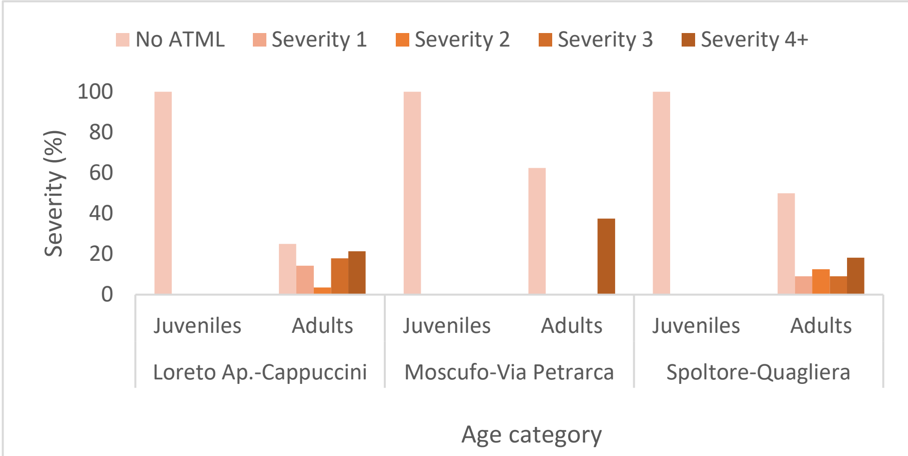

Figure 6.23 Prevalence of severity in percentages of AMTL for each age category across cemeteries (Severity 1 = 1 tooth lost ante-mortem; severity 2 = 2 teeth lost ante-mortem; severity 3 = 3 teeth lost ante-mortem; severity 4+ = 4 or more teeth lost ante-mortem).

Table 6.27 Prevalence of severity in percentages of AMTL for each sex category across cemeteries (Severity 1 = 1 tooth lost ante-mortem; severity 2 = 2 teeth lost ante-mortem; severity 3 = 3 teeth lost ante-mortem; severity 4+ = 4 or more teeth lost ante-mortem).

Cemetery	**Sex category**		**No AMTL**	**Severity**				**Total**
				1	2	3	4+	
Loreto Ap.-Cappuccini	Female	n	5	2	0	0	6	13
		%	38.5	15.4	0.0	0.0	46.2	100.0
	Male	n	5	2	0	5	0	12
		%	41.7	16.7	0.0	41.7	0.0	100.00
Moscufo-Via Petrarca	Female	n	4	–	–	–	1	5
		%	80.0	–	–	–	20.0	100.0
	Male	n	4	–	–	–	2	6
		%	66.7	_	_	_	33.3	100.0
Spoltore-Quagliera	Female	n	4	2	2	1	3	12
		%	33.3	16.7	16.7	8.3	25.0	100.0
	Male	n	13	0	1	1	1	16
		%	81.3	0.0	6.3	6.3	6.3	100.0

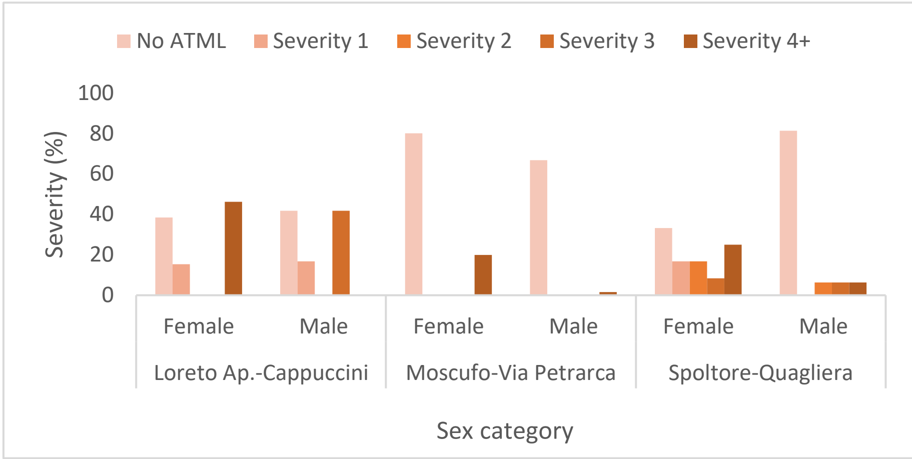

Figure 6.24 Prevalence of severity in percentages of AMTL for each sex category across cemeteries (Severity 1 = 1 tooth lost ante-mortem; severity 2 = 2 teeth lost ante-mortem; severity 3 = 3 teeth lost ante-mortem; severity 4+ = 4 or more teeth lost ante-mortem).

6.4.6 Dental Enamel Hypoplasia (DEH)

Dental enamel hypoplasia was recorded on individuals with anterior teeth suitable for hypoplasia observation. A total of 54 individuals, within the pooled sample, met this condition (N = 30 Loreto Ap.-Cappuccini; N = 6 Moscufo-Via Petrarca; N = 18 Spoltore-Quagliera). Of these, 17 were immatures and 37 were adults, while 23 were females and 24 were males. TPR of DEH for the pooled sample was 68.5% (Table 6.28). The prevalence rate for immatures and adults was 52.9% and 75.7%, respectively. There was no statistically significant difference between the two categories. Within each sex category, 73.9% of females and 79.2% of males exhibited DEH. The individuals at Loreto Ap.-Cappuccini sowed the highest prevalence of DEH (83.3%).

There was low prevalence of DEH within the category of children: only one child out of three exhibited DEH (33.3%) at Loreto Ap.-Cappuccini (Figure 6.25). The increase in prevalence of DEH with increasing age was visible at Loreto Ap.-Cappuccini, while a different pattern was observed at Moscufo-Via Petrarca and Spoltore-Quagliera. In the latter cemetery there was an increase in prevalence of DEH from juveniles to young adults, followed by a decrease in the middle adult age category. Figure 6.26 shows that all females and males at Loreto Ap.-Cappuccini exhibited DEH (females = 100.0%, males = 100.0%), while males presented higher prevalence than females at Moscufo-Via Petrarca (females = 33.3%, males = 100.0%) and Spoltore-Quagliera (females = 48.9%, males = 50.0%). The datum regarding the Moscufo-Via Petrarca cemetery might have been conditioned by the small sample size.

The severity of DEH was analysed for each age (Table 6.29, Figure 6.27) and sex (Table 6.30, Figure 6.28) category across the cemeteries. Overall both juveniles and adults across the cemeteries were exhibiting severity grade 1 and 2. Gross enamel defects were observed in a child and an adult individual from Loreto Ap.-Cappuccini (Figure 6.27). Within the sex category, males overall exhibited slightly higher prevalence of mild defects (grade 1) compared to females. While females at Loreto Ap.-Cappuccini and Spoltore-Quagliera showed slightly higher prevalence of moderate defects (grade 2) compared to males (Figure 6.28).

Table 6.28 Prevalence rates in percentages of DEH for each age and sex category across cemeteries.

Age category		**Loreto Ap.-Cappuccini**					**Moscufo-Via Petrarca**				**Spoltore-Quagliera**				**TOTAL**
		Female	Male	Ambiguous	Unsexed	Total	Female	Male	Unsexed	Total	Female	Male	Unsexed	Total	
Infants	n/N	–	–	–	0/1	0/1	–	–	–	–	–	–		–	0/1
	%	–	–	–	0.0	0.0	–	–	–	–	–	–	–	–	0.0
Children	n/N	0/0	0/0	0/0	1/3	1/3	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	1/3
	%	0.0	0.0	0.0	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3
Juveniles	n/N	3/3	1/1	0/1	0/0	4/5	1/2	0/0	0/0	1/2	1/1	2/4	0/1	3/6	8/13
	%	100.0	100.0	0.0	0.0	80.0	50.0	0.0	0.0	50.0	100.0	50.0	0.0	50.0	61.5
Young adults	n/N	3/3	6/6	0/0	0/1	9/10	0/0	1/1	0/0	1/1	1/2	3/4	0/0	4/6	14/17
	%	100.0	100.0	0.0	0.0	90.0	0.0	100.0	0.0	100.0	50.0	60.0	0.0	66.6	82.4
Middle adults	n/N	3/3	**3/3**	0/0	0/0	6/6	0/1	1/1	0/0	1/2	1/2	0/2	0/0	1/4	8/12
	%	100.0	100.0	0.0	0.0	100.0	0.0	100.0	0.0	50.0	50.0	0.0	0.0	25.0	66.6
Old adults	n/N	4/4	1/1	0/0	0/0	5/5	0/0	1/1	0/0	1/1	0/2	0/0	0/0	0/2	6/8
	%	100.0	100.0	0.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	0.0	0.0	0.0	75.0
TOTAL	n/N	13/13	11/11	0/1	1/5	**25/30**	1/3	3/3	0/0	**4/6**	3/7	5/10	0/1	**8/18**	**37/54**
	%	100.0	100.0	0.0	20.0	**83.3**	33.3	100.0	0.0	**66.7**	48.9	50.0	0.0	**44.4**	**68.5**

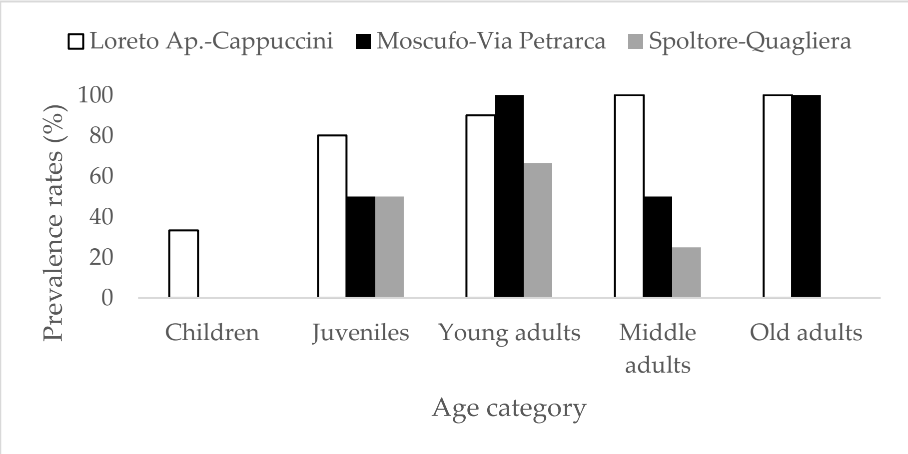

Figure 6.25 Prevalence rates in percentages of DEH for each age category across cemeteries.

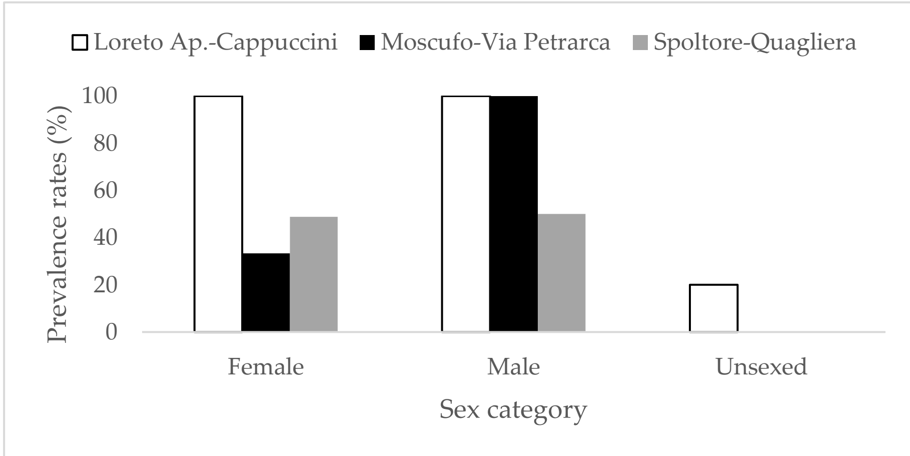

Figure 6.26 Prevalence rates in percentages of DEH for each sex category across cemeteries.

Table 6.29 Prevalence and severity in percentages of DEH for each age category across cemeteries (Grade: 1 = just discernible line, grade 2 = clear groove, grade 3 = gross defects).

Cemetery	Age category		No DEH	Grade 1	Grade 2	Grade 3	Total
Loreto Ap.-Cappuccini	Children	n	2	0	0	1	3
		%	66.7	0.0	0.0	33.3	100
	Juveniles	n	1	2	2	0	5
		%	20.0	40.0	40.0	0.0	100.0
	Adults	n	2	11	7	1	21
		%	9.5	52.4	33.3	4.8	100.0
Moscufo-Via Petrarca	Juveniles	n	1	1	0	_	2
		%	50.0	20.0	0.0	_	100.0
	Adults	n	1	2	1	_	4
		%	25.0	50.0	25.0	_	100.0
Spoltore-Quagliera	Juveniles	n	3	1	2	_	6
		%	50.0	16.7	33.3	_	100.0
	Adults	n	7	3	2	_	12
		%	58.3	25.0	16.7	_	100.0

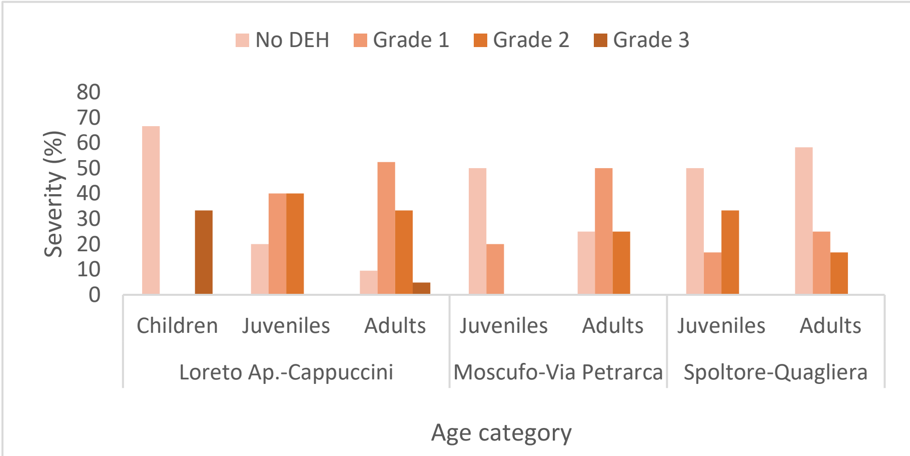

Figure 6.27 Prevalence and severity in percentages of DEH for each age category across cemeteries (Grade: 1 = just discernible line, grade 2 = clear groove, grade 3 = gross defects).

Table 6.30 Prevalence and severity in percentages of DEH for each sex category across cemeteries (Grade: 1 = Just discernible line, grade 2 = clear groove, grade 3 = gross defects).

Cemetery	**Sex category**		**No DEH**	**Grade**			**Total**
				1	2	3	
Loreto Ap.-Cappuccini	Female	n	1	7	5	0	13
		%	7.7	53.8	38.5	0.0	100.0
	Male	n	0	6	4	1	11
		%	0.0	54.5	36.4	9.1	100.00
Moscufo-Via Petrarca	Female	n	2	1	0	_	3
		%	66.7	33.3	0.0	_	100.0
	Male	n	0	2	1	_	3
		%	0.0	66.7	33.3	_	100.0
Spoltore-Quagliera	Female	n	4	1	2	_	7
		%	57.1	14.3	28.6	_	100.0
	Male	n	5	3	2	_	10
		%	50.0	30.0	20.0	_	100.0

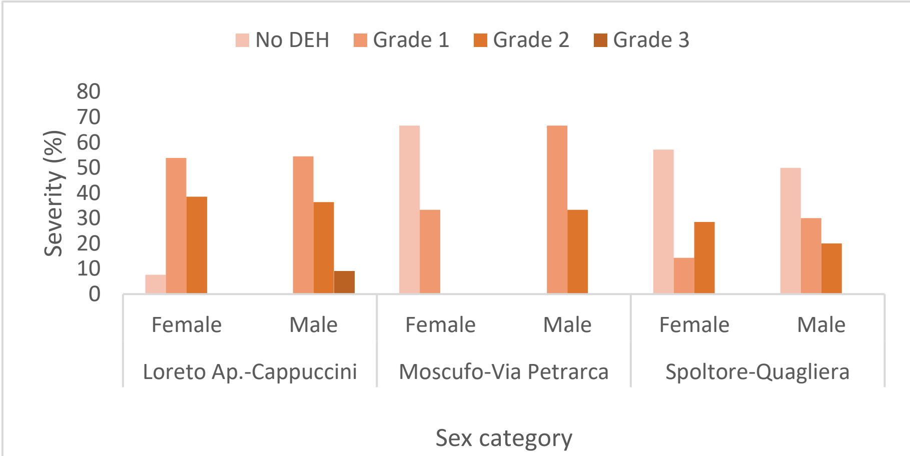

Figure 6.28 Prevalence and severity in percentages of DEH for each sex category across cemeteries (Grade: 1 = Just discernible line, grade 2 = clear groove, grade 3 = gross defects).

6.5 Skeletal Health

6.5.1 Infectious Diseases

6.5.1.1 Endocranial Lesions

Endocranial lesions were recorded on individuals with at least 50% of the skull vault preserved. A total of 73 individuals, within the total combined sample, met this condition (N = 32 Loreto Ap.-Cappuccini; N = 11 Moscufo-Via Petrarca; N = 30 Spoltore-Quagliera). Of these, 22 were immatures and 51 were adults, while 31 were females and 32 were males. True prevalence rate of endocranial lesions for the pooled sample was 4.1% (3/73). Table 6.31 shows the individuals who exhibited the lesions across the cemeteries. Overall there was a very low prevalence and no male were showed the lesions. The individuals in burial T21 from Moscufo-Via Petrarca and T6 from Spoltore-Quagliera exhibited fibre bone formation on the endocranial surface of the frontal bone, while the individual from Loreto Ap.-Cappuccini showed capillary lesions.

Table 6.31 Endocranial lesions across the studied cemeteries.

Cemetery	Burial	Age	Sex	Observation (Lewis, 2004)
Loreto Ap.-Cappuccini	T32	18-20	Female	Capillary lesions on the endocranial surface of frontal bone
Moscufo-Via Petrarca	T21	15-18	Female	Fibre bone formation on the endocranial surface of frontal bone
Spoltore-Quagliera	T6	12-15	Unsexed	Fibre bone formation on the endocranial surface of frontal bone

6.5.1.1 Sinusitis

Inflammation of the maxillary sinuses was recorded on individuals with at least one maxillary sinus suitable for the observation. A total of 37 individuals, within the pooled sample, met this condition (N = 17 Loreto Ap.-Cappuccini; N = 5 Moscufo-Via Petrarca; N = 15 Spoltore-Quagliera). Of these, 11 were immatures and 26 were adults, while 11 were females and 23 were males. True prevalence rate of sinusitis for the pooled sample was 10.8% (4/37). No presence of sinus inflammation was observed at Moscufo-Via Petrarca cemetery and in the female sex category across the three cemeteries. The individuals showing maxillary sinusitis are presented in Table 6.32. A juvenile and an adult individual at Spoltore-Quagliera exhibited spicules-type bone formation on the maxillary bone (13.3%, 2/15), while two adult males at Loreto Ap.-Cappuccini (18.8%, 2/17) showed remodelled (T11) and spicules-type bone formation (T14) within the sinus.

Table 6.32 Individuals exhibiting maxillary sinusitis across the cemeteries.

Cemetery	**Burial**	**Age**	**Sex**	**Observation (Boocock *et al.*, 1995)**
Loreto Ap.-Cappuccini	T11	40-50	Male	Remodelled spicules of new bone
	T14	50+	Male	Spicules-type bone formation
Spoltore-Quagliera	T10	18-22	Probable male	Spicules-type bone formation
	T22	36-40	Male	Spicules-type bone formation

6.5.2 Cribra Orbitalia

Cribra orbitalia was recorded on individuals with at least one orbit suitable for observation. A total of 22 individuals, within the total combined sample, met this condition (N = 8 Loreto Ap.-Cappuccini; N = 3 Moscufo-Via Petrarca; N = 11 Spoltore-Quagliera). Of these, 5 were immatures and 17 were adults, while 9 were females and 12 were males. No cases of cribra orbitalia were observed at Moscufo-Via Petrarca therefore the site was not included in the calculation of the true prevalence rate. Table 6.33 shows the prevalence of cribra for age and sex categories at Loreto Ap.-Cappuccini and Spoltore-Quagliera. Overall, there were only few individuals who exhibited the lesion in the two cemeteries (31.6%), and the majority of them were juveniles (80.0%).

Table 6.33 Prevalence rate in percentages of cribra orbitalia for each age and sex category at Loreto Ap.-Cappuccini and Spoltore-Quagliera cemeteries.

Age category		**Loreto Ap.-Cappuccini**				**Spoltore-Quagliera**			**TOTAL**
		Female	Male	Ambiguous	Total	Female	Male	Total	
Juveniles	n/N	1/1	_	1/1	2/2	_	2/3	2/3	4/5
	%	100.0	_	100.0	100.0	_	66.7	66.7	80.0
Young adults	n/N	_	0/2	_	0/2	0/2	0/2	0/4	0/6
	%	_	0.0	_	0.0	0.0	0.0	0.0	0.0
Middle adults	n/N	1/2	0/1	_	1/3	1/2	0/2	1/4	2/7
	%	50.0	0.0	_	33.3	50.0	0.0	25.0	28.6
Old adults	n/N	0/1	_	_	0/1	_	_	_	0/1
	%	0.0	_	_	0.0	_	_	_	0.0
Total	n/N	2/4	0/3	1/1	**3/8**	1/4	2/7	**3/11**	**6/19**
	%	50.0	0.0	100.0	**37.5**	25.0	28.6	**27.3**	**31.6**

6.5.3 Joint Diseases

6.5.3.1 Appendicular Joint Disease

Each joint surface was examined separately for evidence of osteoarthritis and then pooled in joint complexes to present the results. The prevalence rates for each joint complex were calculated for the number of individuals with at least one joint surface preserved. Table 6.34 presents the prevalence rate analysed for each joint complex and compared in each age and sex categories and across cemeteries. Results showed that evidence for osteoarthritis was moderate in all the joint complexes (Figure 6.29). With the exception of the elbow joints, frequencies were generally higher in the Loreto Ap.-Cappuccini sample compared to the two other cemeteries. The major differences were observed in the ankle/foot (36.4%), the shoulder (23.8%), the wrist/hand (28.0%), and the hip (20.0%). The lowest prevalence rates for osteoarthritis were observed in the Spoltore-Quagliera sample.

Table 6.34 Prevalence rates in percentages of osteoarthritis of the joint complexes for each age and sex group category across cemeteries.

Age category	Sex		Loreto Ap.-Cappuccini						Moscufo-Via Petrarca						Spoltore-Quagliera					
			Shoulder	Elbow	Wrist/Hand	Hip	Knee	Ankle/Foot	Shoulder	Elbow	Wrist/Hand	Hip	Knee	Ankle/Foot	Shoulder	Elbow	Wrist/Hand	Hip	Knee	Ankle/Foot
Adolescent	Female	n/N	0/3	0/3	0/3	0/3	0/2	0/2	–	0/3	0/3	0/3	0/2	0/1	–	0/1	0/1	–	–	–
		%	0.0	0.0	0.0	0.0	0.0	0.0	–	0.0	0.0	0.0	0.0	0.0	–	0.0	0.0	–	–	–
	Male	n/N	–	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/2	0/2	0/2	0/1	0/4	0/5	0/5	0/4	0/4	0/4
		%	–	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Ambiguous	n/N	–	0/1	0/1	0/1	0/1	–	–	–	–	–	–	–	–	–	–	–	–	–
		%	–	0.0	0.0	0.0	0.0	–	–	–	–	–	–	–	–	–	–	–	–	–
	Unsexed	n/N	0/1	–	–	–	–	–	0/1	0/1	–	0/1	0/1	0/1	–	–	–	–	0/1	–
		%	0.0	–	–	–	–	–	0.0	0.0	–	0.0	0.0	0.0	–	–	–	–	0.0	–
Young adults	Female	n/N	0/2	0/3	0/2	0/2	0/3	1/2		–	–	–	–	–	0/1	0/4	1/3	0/2	0/2	0/2
		%	0.0	0.0	0.0	0.0	0.0	50.0		–	–	–	–	–	0.0	0.0	33.3	0.0	0.0	0.0
	Male	n/N	1/5	0/6	1/6	1/6	1/6	3/6	0/3	0/2	1/2	0/2	0/2	0/1	0/5	0/7	0/7	0/6	0/5	0/6
		%	20.0	0.0	16.7	16.7	16.7	50.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0
Middle adults	Female	n/N	2/3	1/3	1/3	1/3	1/3	1/3	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/3	0/3	0/3	0/2	0/3
		%	66.7	33.3	33.3	33.3	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0
	Male	n/N	1/3	0/4	1/4	1/4	0/3	0/3	0/1	0/1	1/1	0/1	–	0/1	1/4	0/4	1/4	0/4	0/4	0/4
		%	33.3	0.0	25.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	–	0.0	25.0	0.0	25.0	0.0	0.0	0.0
Old adults	Female	n/N	0/3	0/4	3/4	1/4	1/4	2/4	0/1	0/1	0/1	1/1	–	–	0/1	0/2	0/2	1/4	1/1	0/1
		%	0.0	0.0	75.0	25.0	25.0	50.0	0.0	0.0	0.0	100.0	–	–	0.0	0.0	0.0	25.0	100.0	0.0
	Male	n/N	1/1	1/1	1/1	1/1	1/1	1/1	–	1/1	0/1	0/2	0/1	–	–	–	–	–	–	–
		%	100.0	100.0	100.0	100.0	100.0	100.0	–	100.0	0.0	0.0	0.0	–	–	–	–	–	–	–
Unknown age	Female	n/N	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
		%	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Male	n/N	–	–	–	–	–	–	0/1	–	–	–	–	–	–	–	–	–	–	–
		%	–	–	–	–	–	–	0.0	–	–	–	–	–	–	–	–	–	–	–
TOTAL		n/N	5/21	2/26	7/25	5/25	4/24	8/22	0/9	1/11	2/11	1/13	0/9	0/6	1/16	0/26	2/25	1/23	1/19	0/20
		%	23.8	7.7	28.0	20.0	16.7	36.4	0.0	9.1	18.2	7.7	0.0	0.0	6.3	0.0	8.0	4.3	5.3	0.0

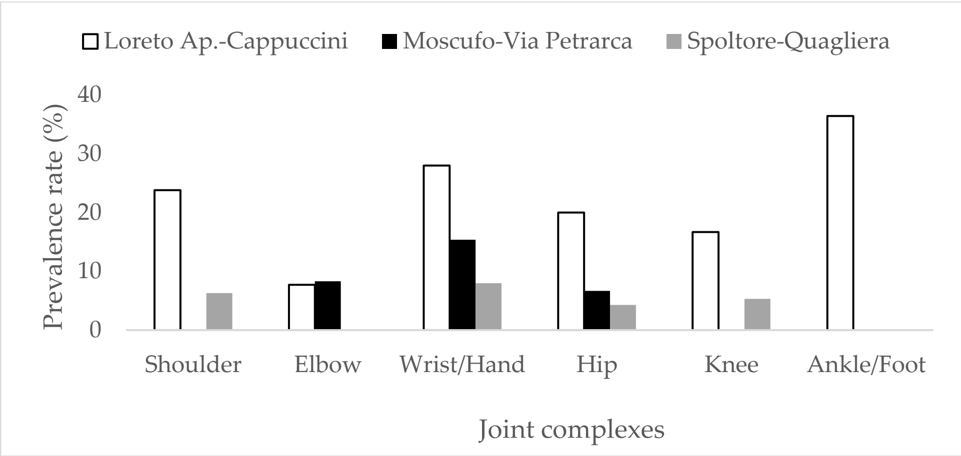

Figure 6.29 Prevalence rates in percentages of osteoarthritis for each joint complex across cemeteries.

When analysing the juvenile and adult age category, the prevalence of osteoarthritis was observed on the adult individuals, whilst juveniles did not exhibit any osteoarthritic lesions (Figure 6.30). With the exception of the joint of the shoulder, old adults at Loreto Ap.-Cappuccini showed higher prevalence of osteoarthritis than middle and young adults. Figure 6.31 presents the prevalence of osteoarthritis for each sex category. Both males and females at Spoltore-Quagliera exhibited lower prevalence of osteoarthritis compared to Loreto Ap.-Cappuccini and Moscufo-Via Petrarca. Differences were observed within the Loreto cemetery, where females presented higher prevalence of osteoarthritis than males. The only exceptions were for the shoulder and the hip. Statistical analyses to test whether there was a significant different between age groups and sexes were not carried out due to the small number of observations acquired.

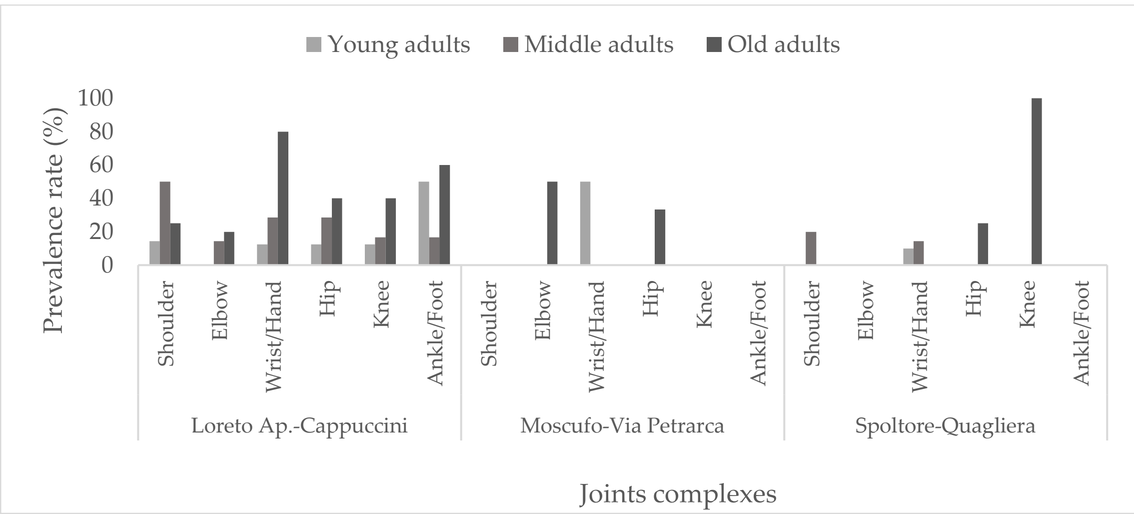

Figure 6.30 Prevalence rates in percentages of osteoarthritis of each joint complex for each age group across cemeteries.

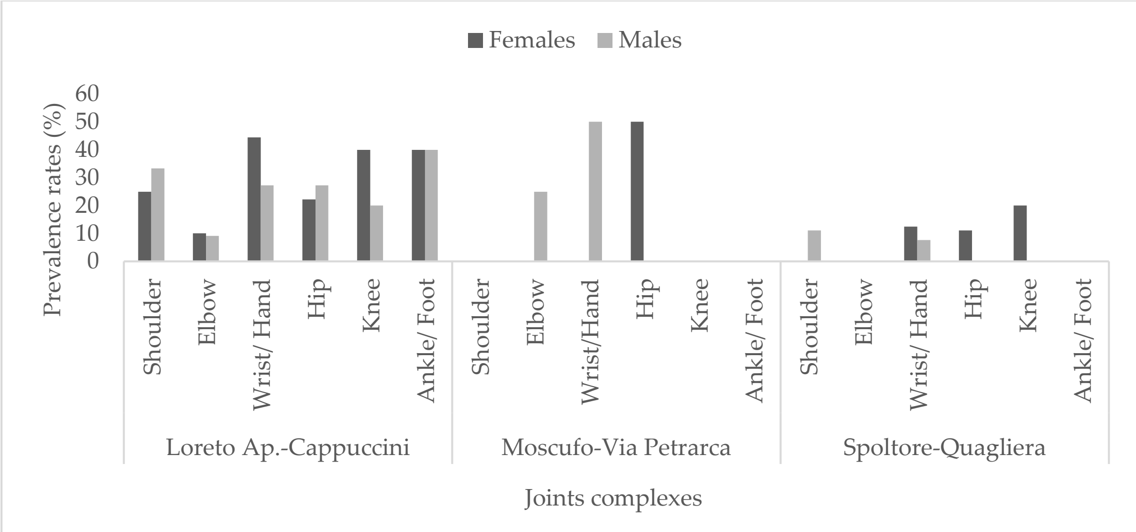

Figure 6.31 Prevalence rates in percentages of osteoarthritis of each joint complex for each sex category across cemeteries.

The severity of osteoarthritis for each joint complex is presented in Table 6.35 and Figure 6.32. Overall, most of the individuals in the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries presented slight or moderate osteoarthritic conditions. Two cases of severe degenerative changes were observed in the Loreto Ap.-Cappuccini and in the Moscufo-Via Petrarca samples; in both cases the wrist/hand joint was affected.

Table 6.35 Prevalence rates in percentages of severity of osteoarthritis for each joint complex across cemeteries (Grade 2 = Slight, Grade 3 = Moderate, Grade 4 = Severe degenerative changes) (Steckel et al., 2006: 32,33). ADJD = Appendicular Joint Disease).

Joint complexes		**Loreto Ap.-Cappuccini**				**Moscufo-Via Petrarca**				**Spoltore-Quagliera**			
		Grade				Grade				Grade			
		no ADJD	2	3	4	No ADJD	2	3	4	No ADJD	2	3	4
Shoulder	n/N	16/21	14/21	1/21	0/21	15/16	1/16	0/16	0/16	16/16	_	_	_
	%	76.2	66.6	4.8	0.0	93.8	6.3	0	0	100.0	_	_	_
Elbow	n/N	24/26	2/26	0/26	0/26	11/12	1/12	0/12	0/12	26/26	_	_	_
	%	92.3	7.7	0.0	0.0	91.7	8.3	0.0	0.0	100.0	_	_	_
Wrist/Hand	n/N	18/25	5/25	1/25	1/25	11/13	1/13	_	1/13	23/25	_	2/25	_
	%	72.0	20.0	4.0	4.0	84.6	7.7	_	7.7	92.0	_	8.0	_
Hip	n/N	20/25	4/25	1/14	_	14/15	1/15	_	_	22/23	_	1/23	_
	%	80.0	16.4	4.0	_	93.3	6.7	_	_	95.7	_	4.3	_
Knee	n/N	20/24	3/24	1/24	_	11/11	_	_	_	18/19	_	1/19	_
	%	83.3	12.5	4.2	_	100.0	_	_	_	94.7	_	5.3	_
Ankle/Foot	n/N	14/22	6/22	2/22	_	9/9	_	_	_	20/20	_	_	_
	%	63.6	27.3	9.1	_	100.0	_	_	_	100.0	_	_	_

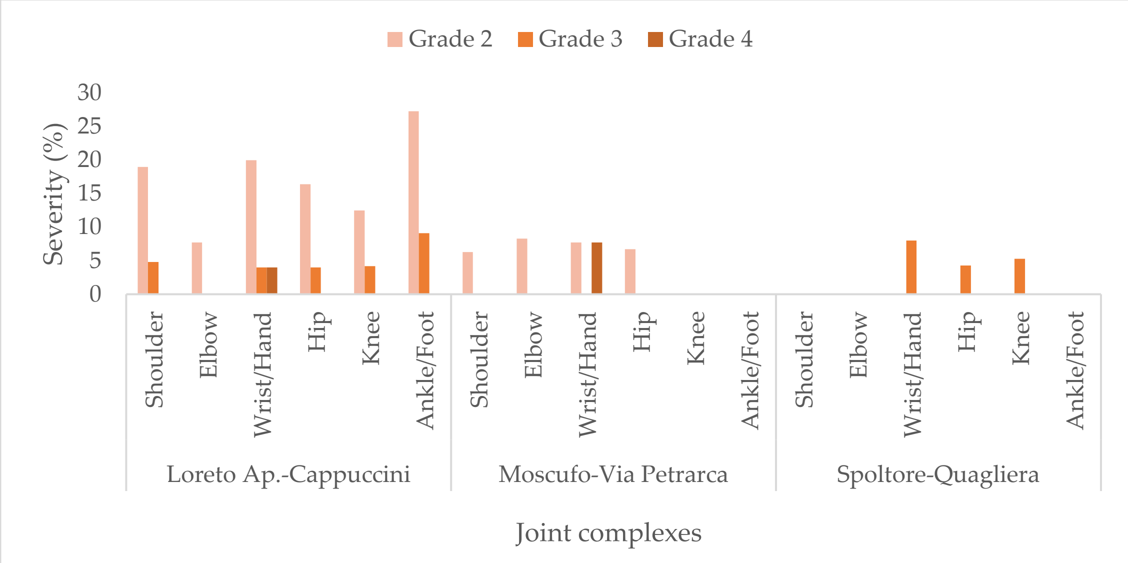

Figure 6.32 Prevalence rates in percentages of severity of osteoarthritis for each joint complex for each cemetery (Grade 2 = Slight, Grade 3 = Moderate, Grade 4 and grade 5 = Severe degenerative changes), (Steckel et al., 2006: 32,33).

6.5.3.2 Pathological Condition of the Spine

6.5.3.2.1 Spinal Osteoarthritis

Spinal osteoarthritis was recorded on individuals with at least one cervical, thoracic or lumbar vertebra present. The prevalence rates of osteoarthritis for each synovial joint is presented in Table 6.36 and Figure 6.33. The true prevalence rate of osteoarthritis for cervical vertebrae for the pooled sample was 47.8%, for thoracic vertebrae was 26.7%, and for lumbar vertebrae was 48.5%. The prevalence rate of spinal osteoarthritis was higher in the Loreto Ap.-Cappuccini cemetery compared to Moscufo-Via Petrarca and Spoltore-Quagliera. Cervical and lumbar vertebrae were the most affected sections of the spine within the Loreto sample (cervical = 66.7%; lumbar = 71.4%). At Spoltore-Quagliera the prevalence rates were lower, with 28.6% of individuals showing cervical osteoarthritis, and 30.8% showing the pathology on lumbar vertebrae. The difference in the prevalence of osteoarthritis was no statistically significant for lumbar vertebrae across cemeteries (χ^2 = 4.976, p = 0.081). However, there was statistically significant difference for cervical vertebrae (χ^2 = 8.025, p = 0.018) across the cemeteries.

Table 6.36 Prevalence rates in percentages of spinal osteoarthritis for each age and sex category across cemeteries (C = cervical vertebrae, T = thoracic vertebrae, L = lumbar vertebrae).

Age category	**Sex**		**Loreto Ap.-Cappuccini**			**Moscufo-Via Petrarca**			**Spoltore-Quagliera**		
			C	T	L	C	T	L	C	T	L
Children	Unsexed	n/N	0/2	0/1	0/1	_	_	_	_	_	_
		%	0.0	0.0	0.0	_	_	_	_	_	_
Juveniles	Female	n/N	1/3	0/1	0/1	0/2	0/2	0/2	0/2	_	_
		%	33.3	0.0	0.0	0.0	0.0	0.0	0.0	_	_
	Male	n/N	1/1	_	_	0/1	_	0/1	1/4	1/2	1/4
		%	100.0	_	_	0.0	_	0.0	25.0	50.0	25.0
	Ambiguous	n/N	0/1	0/1	1/1	_	_	_	_	_	_
		%	0.0	0.0	100.0	_	_	_	_	_	_
	Unsexed	n/N	_	_	_	0/1	_	_	0/2	_	_
		%	_	_	_	0.0	_	_	0.0	_	_
Young adults	Female	n/N	1/3	1/1	_	1/1	_	_	0/3	0/1	0/1
		%	33.3	100.0	_	100.0	_	_	0.0	0.0	0.0
	Male	n/N	6/6	2/5	4/5	1/2	0/1	1/1	3/7	0/4	1/4
		%	100.0	40.0	80.0	50.0	0.0	100.0	42.9	0.0	25.0
Middle adults	Female	n/N	3/3	1/2	2/2	0/1	_	1/1	0/2	0/1	1/1
		%	100.0	50.0	100.0	0.0	_	100.0	0.0	0.0	100.0
	Male	n/N	3/4	1/1	1/1	1/1	0/1	0/1	2/4	0/2	1/3
		%	75.0	100.0	100.0	100.0	0.0	0.0	50.0	0.0	33.3
Old adults	Female	n/N	2/3	2/3	1/2	1/1	0/1	_	2/4	_	_
		%	66.7	66.7	50.0	100.0	0.0	_	50.0	_	_
	Male	n/N	1/1	_	1/1	2/2	_	_	_	_	_
		%	100.0	_	100.0	100.0	_	_	_	_	_
TOTAL		n/N	18/27	7/15	10/14	6/12	0/5	2/6	8/28	1/10	4/13
		%	66.7	46.7	71.4	50.0	0.0	33.3	28.6	10.0	30.8

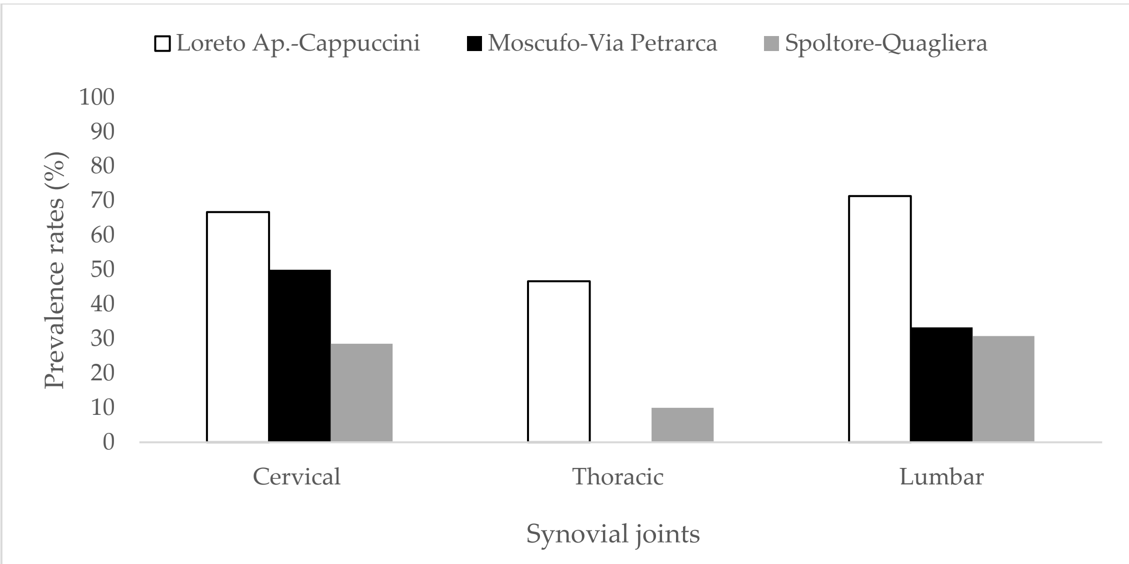

Figure 6.33 Prevalence rates in percentages of osteoarthritis for each synovial joint across cemeteries

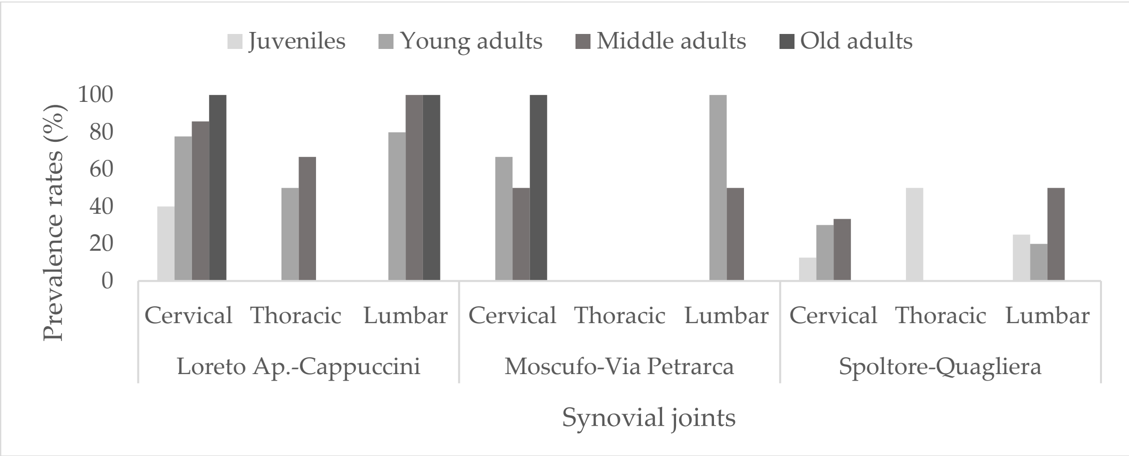

Figure 6.34 Prevalence rates in percentages of osteoarthritis for each synovial joint for each age category and across cemeteries.

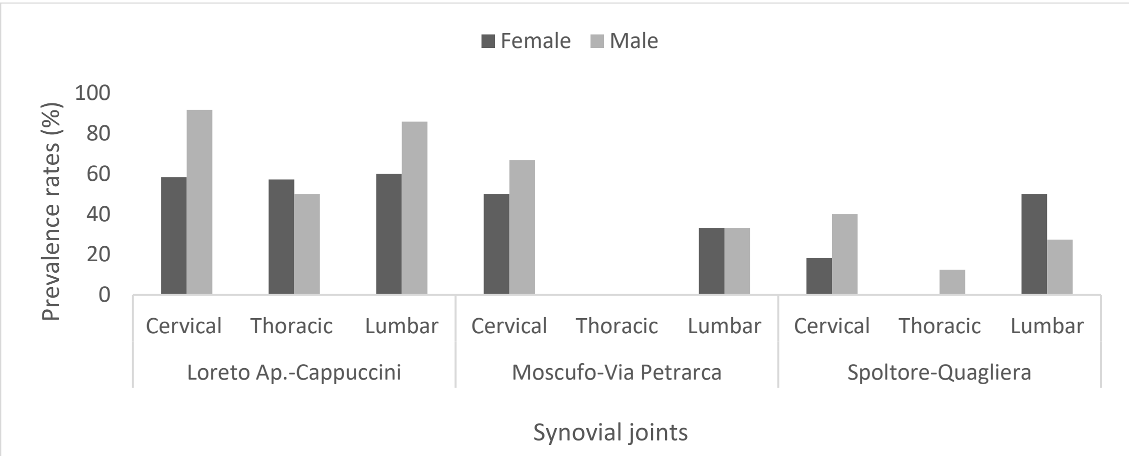

Figure 6.35 Prevalence rates in percentages of osteoarthritis for each synovial joint for each sex category and across cemeteries.

Figure 6.34 shows the distribution of spinal osteoarthritis within the age categories and across cemeteries. Middle and old adult individuals in the Loreto Ap.-Cappuccini cemetery exhibited higher prevalence of osteoarthritis on cervical (85.7%) and on lumbar vertebrae (100.0%) compared to the other two cemeteries. When sex is considered, overall males exhibited higher prevalence of osteoarthritis than females for each vertebral section, with the exceptions of the thoracic vertebrae at Loreto Ap.-Cappuccini and the lumbar vertebrae at Spoltore-Quagliera (Figure 6.35).

The severity of spinal osteoarthritis is presented in Table 6.37 and Figure 6.36. The prevalence rate of severity grade 4 was observed only on cervical vertebrae, with the individuals of Loreto Ap.-Cappuccini and Moscufo-Via Petrarca being the most affected

(Loreto Ap.-Cappuccini: 7.4%, Moscufo-Via Petrarca: 8.3%). High prevalence rate of severity grade 2 and grade 3 was observed in lumbar vertebrae across the cemeteries.

Table 6.37 Prevalence rates in percentages of severity of synovial joints for each cemetery (Grade 1 = Barely discernible OA, Grade 2 = OA with elevated rims, Grade 3 = Curved spicules, Grade 4 = Fusion of the Spicules).

Joint complexes		**Loreto Ap.-Cappuccini**					**Moscufo-Via Petrarca**					**Spoltore-Quagliera**				
		Grade					Grade					Grade				
		no SDJD	1	2	3	4	no SDJD	1	2	3	4	no SDJD	1	2	3	4
Cervical	n/N	9/27	6/27	6/27	4/27	2/27	6/12	4/12	1/12	_	1/12	20/28	1/28	6/28	1/28	_
	%	33.3	22.2	22.2	14.8	7.4	50.0	33.3	8.3	_	8.3	71.4	3.6	21.4	3.6	_
Thoracic	n/N	8/15	2/15	2/15	3/15	_	_	_	_	_	_	9/10	1/10	_	_	_
	%	53.3	13.3	13.3	20.3	_	_	_	_	_	_	90.0	10.0	_	_	_
Lumbar	n/N	4/14	1/14	5/14	4/14	_	4/6	1/6	_	1/6	_	9/13	1/13	1/13	2/13	_
	%	28.6	7.1	35.7	28.6	_	66.7	16.7	_	16.7	_	69.2	7.7	7.7	15.4	_

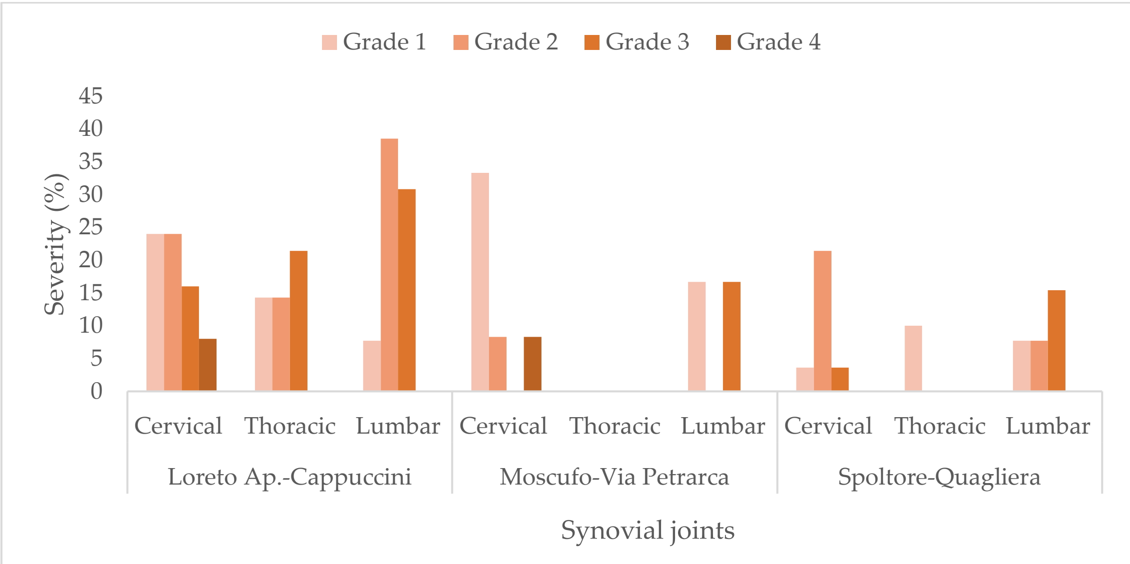

Figure 6.36 Prevalence rates in percentages of severity of osteoarthritis for each synovial joint for each cemetery (Grade 1 = Barely discernible OA, Grade 2 = OA with elevated rims, Grade 3 = Curved spicules, Grade 4 = Fusion of the Spicules).

6.5.3.2.2 Schmorl's Nodes (SN)

Schmorl's nodes (SN) were recorded on individuals with thoracic and lumbar vertebrae suitable for SN observation. Within the pooled sample, 30 individuals possessed at least one thoracic vertebra available for analysis. Of these, 7 were immatures and 23 were adults, while 12 were female and 16 were males. The prevalence for thoracic vertebrae for the pooled sample was 33.3%, while the prevalence rates of SN for thoracic vertebrae of immatures and adults were 42.9% and 30.4%, respectively. The true prevalence rates of SN for thoracic vertebrae of female and male individuals were 41.7% and 31.3%, respectively. Within the pooled sample, 34 individuals possessed at least one lumbar vertebra available for analysis. Of these, 9 were immatures and 25 were adults, while 11 were female and 21 were males. The prevalence rate of SN for lumbar vertebrae for the pooled sample was 20.6%, while the prevalence rates for lumbar vertebrae of immatures and adults were 33.3% and 16.0%, respectively. The true prevalence rates of SN for lumbar vertebrae of female and male individuals were 36.4% and 14.3%, respectively. Table 6.38 and Figure 6.37 present the distribution of Schmorl's nodes for each age and sex category and across the cemeteries.

Table 6.38 Prevalence rates of Schmorl's nodes for each age and sex category across cemeteries.

Age category	**Sex**		**Loreto Ap.-Cappuccini**		**Moscufo-Via Petrarca**		**Spoltore-Quagliera**	
			Thoracic	Lumbar	Thoracic	Lumbar	Thoracic	Lumbar
Children	Unsexed	n/N	0/1	0/1	–	–	–	–
		%	0.0	0.0	–	–	–	–
Juveniles	Female	n/N	1/1	0/1	1/2	2/2	–	–
		%	100.0	0.0	50.0	100.0	–	–
	Male	n/N	–	–	–	0/1	1/2	1/4
		%	–	–	–	0.0	50.0	25.0
	Ambiguous	n/N	0/1	0/1	–	–	–	–
		%	0.0	0.0	–	–	–	–
Young adults	Female	n/N	1/1	–	–	–	0/1	0/1
		%	100.0	–	–	–	0.0	0.0
	Male	n/N	3/5	1/5	0/1	1/1	1/4	0/4
		%	60.0	20.0	0.0	100.0	25.0	0.0
Middle adults	Female	n/N	1/2	1/2	–	0/1	0/1	0/1
		%	50.0	50.0	–	0.0	0.0	0.0
	Male	n/N	0/1	0/1	0/1	0/1	0/2	0/3
		%	0.0	0.0	0.0	0.0	0.0	0.0
Old adults	Female	n/N	1/3	1/3	0/1	–	–	–
		%	33.3	33.3	0.0	–	–	–
	Male	n/N	–	0/1	–	–	–	–
		%	–	0.0	–	–	–	–
TOTAL		n/N	7/15	3/15	1/5	3/6	2/10	1/13
		%	46.7	20.0	20.0	50.0	20.0	7.7

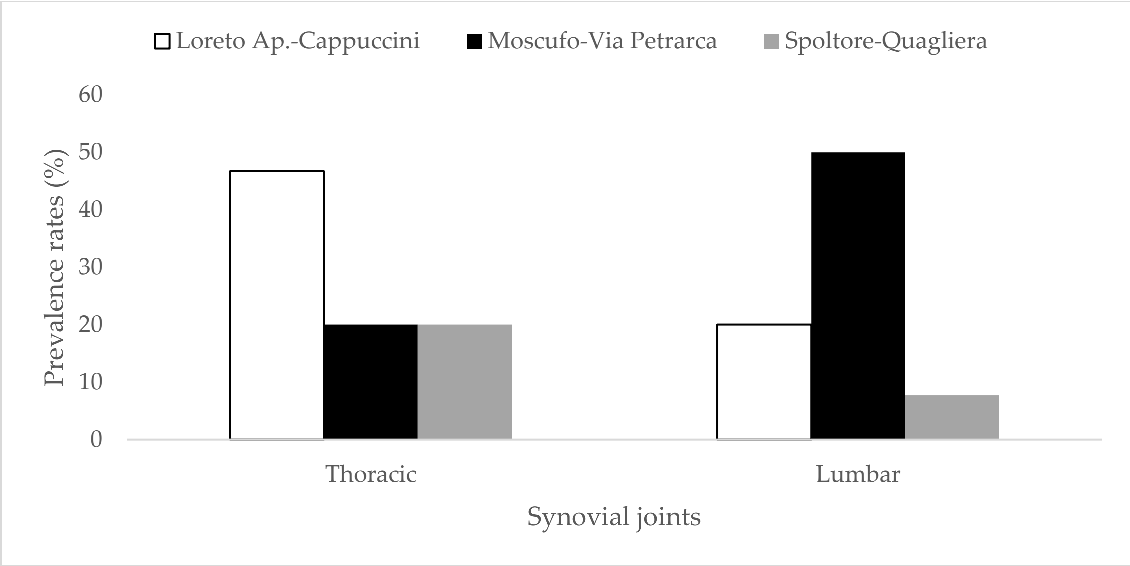

Figure 6.37 Comparison of Schmorl's nodes on thoracic and lumbar vertebrae across cemeteries.

Individuals from Loreto Ap.-Cappuccini exhibited higher prevalence of SN on thoracic vertebrae (46.7%) than the individuals from Moscufo-Via Petrarca (20.0%) and Spoltore-Quagliera (20.0%). The highest prevalence of SN on lumbar vertebrae was instead observed in Moscufo-Via Petrarca (50.0%), while the individuals from Spoltore-Quagliera were the less affected (7.7%). Figure 6.38 and Figure 6.39 show the prevalence of Schmorl's nodes in thoracic and lumbar vertebrae for each age and sex category and across the cemeteries. Middle and old adult females from Loreto Ap.-Cappuccini exhibited SN on both thoracic and lumbar vertebrae. The prevalence of SN on thoracic vertebrae of young adult males was higher in Loreto Ap.-Cappuccini (60%) than in Spoltore-Quagliera (25.0%), no evidence of SN for this age and sex category was recorded in Moscufo-Via Petrarca. In contrast, a different pattern was observed on lumbar vertebrae of young adult males, where the individuals from Loreto Ap.-Cappuccini showed a lower prevalence rate of SN compared to the individuals from Moscufo-Via Petrarca.

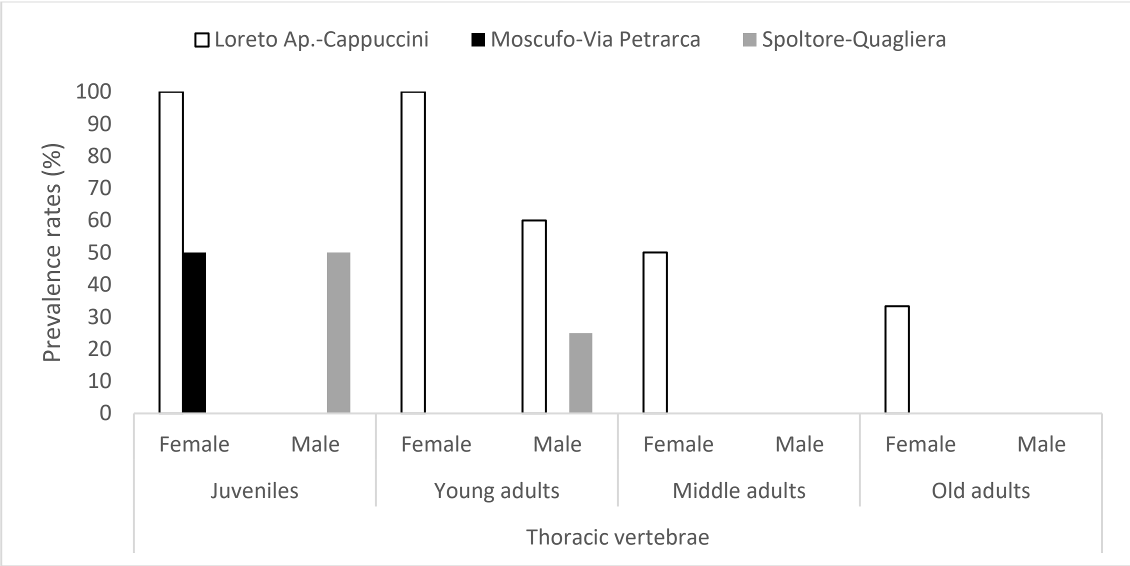

Figure 6.38 Prevalence rates in percentages of thoracic SN for each age and sex category across cemeteries.

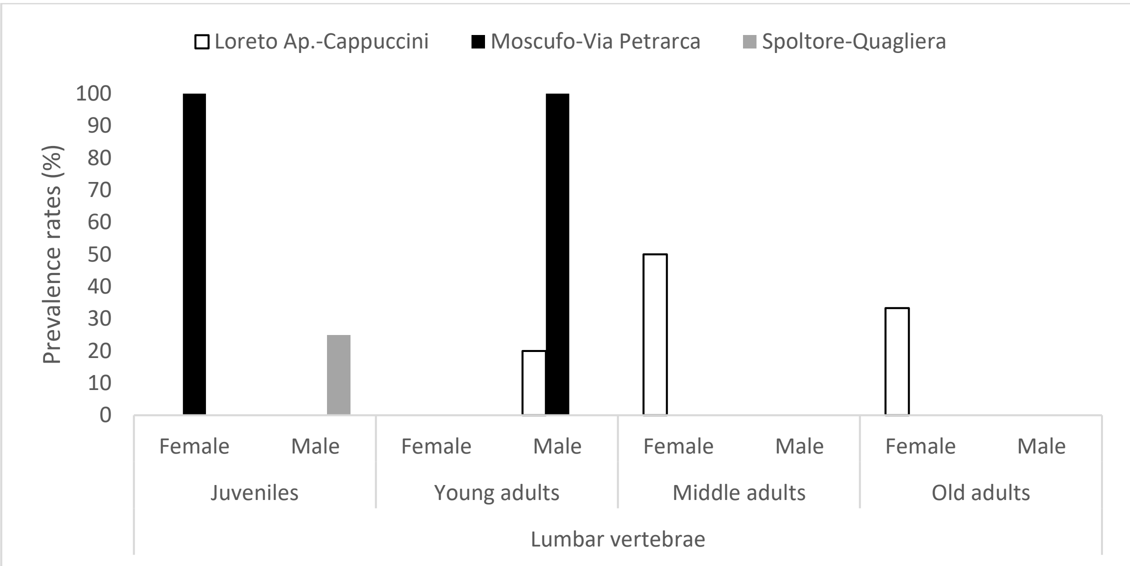

Figure 6.39 Prevalence rates in percentages of lumbar SN for each age and sex category across cemeteries

The distribution of SN severity for thoracic and lumbar vertebrae across cemeteries is presented in Table 6.39 and Figure 6.40. The individuals at Loreto Ap.-Cappuccini exhibited mild and severe SN lesions on the thoracic vertebrae. Within the lumbar vertebrae, severity grade 4 was observed only among the individuals of Moscufo-Via Petrarca (33.0%).

Table 6.39 Prevalence rates in percentages of severity of SN for each spinal joint across cemeteries (Grade 1 = SN present on one plate, Grade 2 = SN present on both plates, Grade 3 = SN with severe depression on one plate, Grade 4 = SN with severe depression on both plates).

Spinal joints		**Loreto Ap.-Cappuccini**					**Moscufo-Via Petrarca**					**Spoltore-Quagliera**				
		Grade					Grade					Grade				
		no SN	1	2	3	4	no SN	1	2	3	4	no SN	1	2	3	4
Thoracic	n/N	8/15	2/15	1/15	2/15	2/15	4/5	_	_	_	1/5	8/10	_	1/10	_	1/10
	%	53.3	13	6.7	13	13	80.0	_	_	_	20	80.0	_	10.0	_	10.0
Lumbar	n/N	12/15	1/15	2/15	0/15	0/15	3	1/6	0/6	0/6	2/6	12/13	0/13	1/13	_	_
	%	80.0	6.7	13	0.0	0.0	50.0	17	0.0	0.0	33	92.3	0.0	7.7	_	_

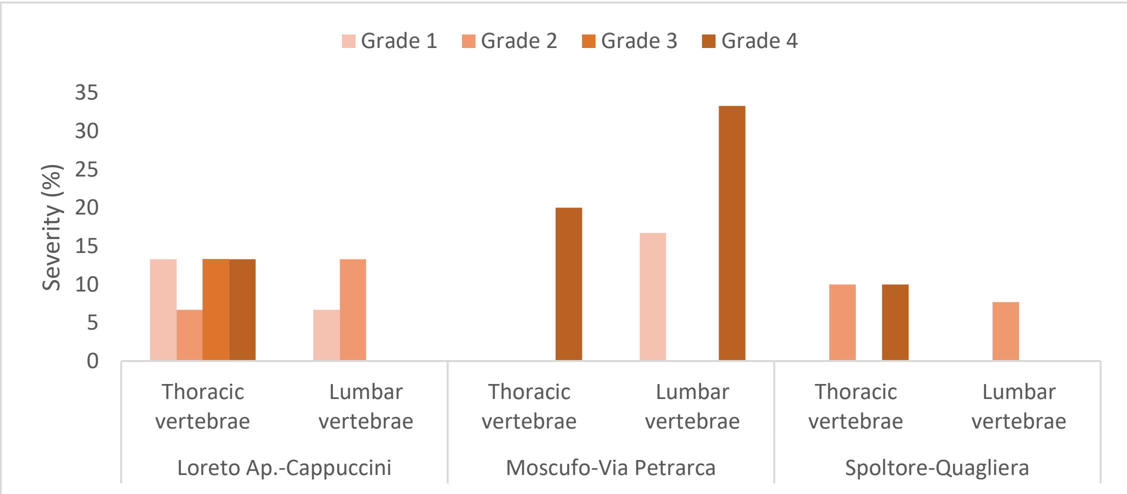

Figure 6.40 Severity of Schmorl's nodes on thoracic and lumbar vertebrae across cemeteries (Grade 1 = SN present on one plate, Grade 2 = SN present on both plates, Grade 3 = SN with severe depression on one plate, Grade 4 = SN with severe depression on both plates).

6.5.4 Trauma

A summary of traumatic lesions observed in individuals from Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera is presented in Table 6.40. Trauma was recorded on individuals with skeletal elements suitable for observation. A total of 83 individuals within the pooled sample met this condition (Loreto Ap.-Cappuccini: N = 33; Moscufo-Via Petrarca: N = 19; Spoltore-Quagliera: N = 31). Whereas a total of 77 individuals exhibited preserved cranial vault available for cranial trauma observation. In the Moscufo-Via Petrarca cemetery there were less skeletons with preserved cranial vault. The total number considered for Moscufo-Via Petrarca was N = 13 instead of N = 19.

Table 6.40 Summary of traumatic lesions observed within Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries.

Cemetery	**Age**	**Sex**	**Trauma location**	**Side**	**Aspect**	**Section**	**Trauma description**
Loreto Ap-Cappuccini	Middle adult	Female	Parietal	Midline	Superior Surface/ Outer table	_	Cranial trauma, penetrating trauma, open shape, possible Edged/Sharp force trauma
	Middle adult	Male	Parietal	Right	Superior Surface/ Outer table	_	Cranial trauma, depressed trauma, inflammation reaction
	Young adult	Male	Parietal	Right	Both Sup/ Inf surfaces; Lateral	_	Cranial trauma, penetrating trauma, wound force trauma or trepanation with sign of healing
	Adolescent	Male	Femur	Right	Anterior	Proximal Epiphysis	Possible depressed trauma. Flat area on the anterior view of right femoral head
	Old adult	Female	Clavicle	Right	Medial	Proximal Epiphysis	Possible fracture (missing half of the epiphysis).
	Old adult	Female	Fibula	Right	Lateral	Distal 1/3 Diaphysis	Possible fracture
	Young adult	Male	Thoracic vertebra (T4)	Midline	Sup Endplate	_	Possible fracture
	Middle adult	Female	Tibia & Fibula	Right		Diaphysis	Healed oblique single angular fracture
Moscufo-Via Petrarca	Middle adult	Probable Male	Ulna	Left	Medial	Distal 1/3 Diaphysis	Healed single oblique fracture. Osteoarthritic reaction at the articular distal epiphysis
Spoltore-Quagliera	Old adult	Probable Female	Radius	Right		Distal 1/3 Diaphysis	Possible healed fracture
	Old adult	Female	Clavicle	Left		Diaphysis	Healed single oblique fracture
	Young adult	Male	Clavicle	Left		Diaphysis	Healing single oblique fracture
	Middle adult	Male	Ulna	Left		Diaphysis	Healed single oblique fracture

6.5.4.1 Fractures

A total of 83 individuals were observed for evidence of fractures. Of these, 25 were immatures, 54 were adults, while 32 were female and 37 were males. The true prevalence rates of fractures for the pooled sample were 12.0%. The true prevalence rates for immatures and adults were 4.0% and 16.7%, respectively. The true prevalence rates for females and males were 15.6% and 13.5%, respectively. There was no statistically significant difference in prevalence of fractures between immatures and adult individuals ($\chi^2 = 3.163$, $p = 0.206$). Similarly, there was no statistically significant difference in prevalence of fractures between female and male individuals ($\chi^2 = 0.062$, $p = 0.804$).

When cemeteries are considered, the prevalence rate of fracture of individuals from Loreto Ap.-Cappuccini and Spoltore-Quagliera was fundamentally the same, with Loreto Ap.-Cappuccini exhibiting slightly higher prevalence rate (15.2%) than Spoltore-Quagliera (12.9%) (Table 6.41). Overall, middle adult and old adult individuals showed the highest prevalence of fracture lesions (Figure 6.41). With regards to the sex category, females of Loreto Ap.-Cappuccini and Spoltore-Quagliera showed higher prevalence of fractures than males (Loreto Ap.-Cappuccini: female = 23.1%, male = 16.7%; Spoltore-Quagliera: female = 16.7%, male = 12.5%) (Figure 6.42). There were no statistically significant differences of prevalence of fractures between sexes within cemeteries and across cemeteries.

Table 6.41 Prevalence rates of fractures for each age and sex category across cemeteries.

Age category		Fracture													
		Loreto Ap.-Cappuccini					**Moscufo-Via Petrarca**				**Spoltore-Quagliera**				**TOTAL**
		Female	Male	Ambiguous	Unsexed	Total	Female	Male	Unsexed	Total	Female	Male	Unsexed	Total	
Infant	n/N	–	–	–	0/1	0/1	–	–	–	–	–	–	–	–	0/1
	%	–	–	–	0.0	0.0	–	–	–	–	–	–	–	–	0.0
Children	n/N	–	–	–	0/4	0/4	–	–	–	–	–	–	0/1	0/1	0/5
	%	–	–	–	0.0	0.0	–	–	–	–	–	–	0.0	0.0	0.0
Juveniles	n/N	0/3	1/1	0/1	–	1/5	0/3	0/2	0/1	0/6	0/1	0/5	0/2	0/8	1/19
	%	0.0	100.0	0.0	–	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3
Young adults	n/N	0/3	1/6	–	0/2	1/11	0/1	0/2	0/1	0/4	0/4	1/7	–	1/11	2/26
	%	0.0	16.7	–	0.0	9.1	0.0	0.0	0.0	0.0	0.0	14.3	–	9.1	7.7
Middle adults	n/N	1/3	0/4	–	–	1/7	0/1	1/1	–	1/2	0/3	1/4	–	1/7	3/16
	%	33.3	0.0	–	–	14.3	0.0	100.0	–	50.0	0.0	25.0	–	14.3	18.8
Old adults	n/N	2/4	0/1	–	–	2/5	0/1	0/2	–	0/3	2/4	–	–	2/4	4/12
	%	50.0	0.0	–	–	40.0	0.0	0.0	–	0.0	50.0	–	–	50.0	33.3
Unknown age	n/N	–	–	–	–	–	0/1	0/2	0/1	0/4	–	–	–	–	0/4
	%	–	–	–	–	–	0.0.	0.0	0.0	0.0	–	–	–	–	0.0
TOTAL	n/N	3/13	1/12	0/1	0/7	**5/33**	0/7	1/9	0/3	**1/19**	2/12	2/16	0/3	**4/31**	**10/83**
	%	23.1	16.7	0.0	0.0	**15.2**	0.0	11.1	0.0	**5.3**	16.7	12.5	0.0	**12.9**	**12.04**

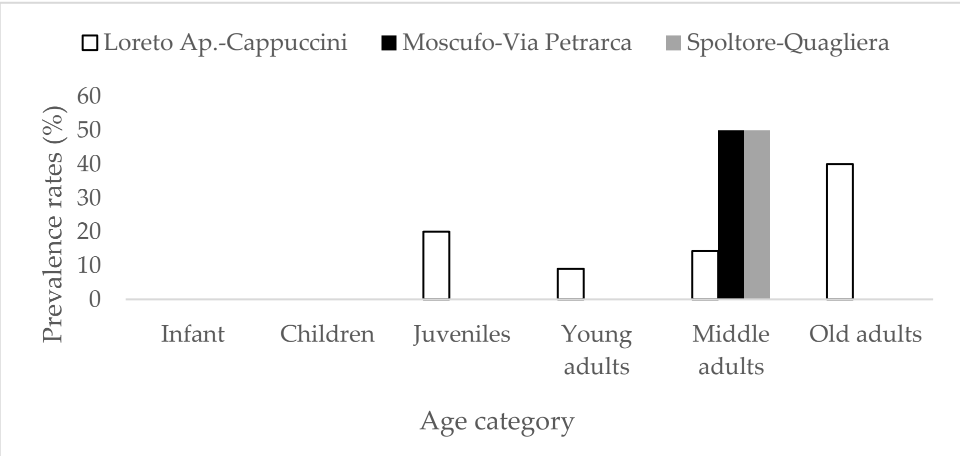

Figure 6.42 Prevalence rates in percentages of fractures for each age category across cemeteries.

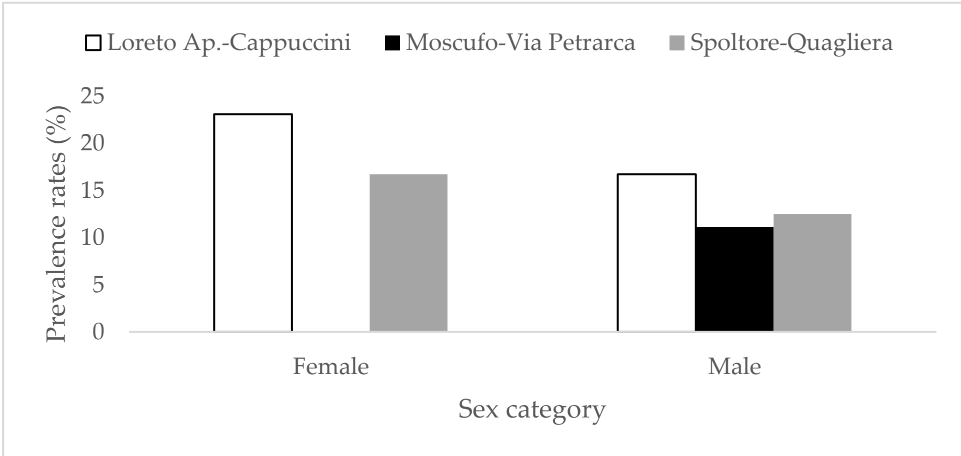

Figure 6.41 Prevalence rates in percentages of fractures for each sex category across cemeteries.

6.5.4.2 Cranial Trauma

A total of 77 individuals were observed for evidence of cranial trauma. Of these, 24 were immatures and 53 were adults, while 31 were females and 34 were males. The true prevalence rates of cranial trauma for the pooled sample were 5.2%. The true prevalence rates for immatures and adults were 4.2% and 5.7%, respectively. The true prevalence rates for females and males were 3.2% and 8.8%, respectively. Overall, there was a low prevalence of cranial trauma, and those individuals exhibiting the lesions were all from the Loreto Ap.-Cappuccini sample. No presence of trauma was evident in Moscufo-Via Petrarca and Spoltore-Quagliera (Table 6.42). Within the cemetery of Loreto Ap.-Cappuccini, only four individuals showed cranial injuries (9.1%). The highest prevalence was observed in males (25.0%) and middle adults (28.6%).

Table 6.42 Prevalence rates in percentages of cranial trauma for each age and sex category across cemeteries.

Cranial trauma						
Age category		**Loreto Ap.-Cappuccini**				
		Female	Male	Ambiguous	Unsexed	Total
Infant	n/N	_	_	_	0/1	0/1
	%	_	_	_	0.0	0.0
Children	n/N	_	_	_	0/4	0/4
	%	_	_	_	0.0	0.0
Juveniles	n/N	0/3	1/1	0/1	_	1/5
	%	0.0	100.0	0.0	_	20.0
Young adults	n/N	0/3	1/6	_	0/2	1/11
	%	0.0	16.7	_	0.0	9.1
Middle adults	n/N	1/3	1/4	_	_	2/7
	%	33.3	25.0	_	_	28.6
Old adults	n/N	0/4	0/1	_	_	0/5
	%	0.0	0.0	_	_	0.0
TOTAL	n/N	1/13	3/12	0/1	0/7	**4/33**
	%	7.7	25.0	0.0	0.0	**12.1**

6.5.5 Miscellaneous Pathologies

This section was dedicated to the individuals exhibiting additional pathologies not considered in the previous sections, including congenital vertebral anomaly, osteoma, hyperostosis of the cranium and abnormal new bone formation (Table 6.43).

Table 6.43 Miscellaneous pathologies.

Individual	Cemetery	Sex	Age	Bone (s) Affected	Observation	Details
T34PEEP2	Loreto Ap.-Cappuccini	M?	30-35	L5 and Sacrum	Sacralisation	_
T30PEEP2	Loreto Ap.-Cappuccini	F	44-50	Right Parietal	Osteoma	Dimensions: W:0.5cm; L: 1cm
				Right Parietal	Osteoma	Dimensions: W:0.5cm; L: 0.5cm
T43PEEP1	Loreto Ap.-Cappuccini	F	50+	Left Parietal	Osteoma	Dimensions: W:1cm; L: 2.5cm
				Sagittal suture	Osteoma	Dimensions: W:1cm; L: 1cm
T14PEEP2	Loreto Ap.-Cappuccini	M	50+	Cranium, palate	Hyperostosis	Abnormal thickening of cranial vault and the palate with presence of porosity.
				Left petrous part	Abnormal new bone formation	Formation of bone tissue on the subarcuate fossa
				Joints left foot	Abnormal new bone formation + porosity and osteophytes	Calcaneus and talus + tarsal bones

The four individuals were all buried in the Loreto Ap.-Cappuccini cemetery. Sacralisation was observed in a probable male individual age at death 30-35 years (T34PEEP2). The points of fusion were between the left transfer process of L5 and the left ala of S1, as well as the left side of L5 inferior vertebral body and the left side of the sacral plateau. Two cases of button osteoma were identified (T30PEEP2 and T43PEEP1), both individuals exhibited two osteomas. The T30PEEP2, a female individual age at death 44-50 years, had two small osteomas on her right parietal. In contrast, the osteomas found in T43PEEP1, an old female individual, had different dimensions and were observed in different areas on the cranium. The larger osteoma (W:1cm; L: 2.5cm) was on the left parietal, while the smaller (W:1cm; L: 1cm) was in proximity of the sagittal suture. A combination of different pathological reactions was observed in the skeleton of an old male individual (T14PEEP2). Individual T14PEEP2 presented an abnormal thickening of the cranial vault and the palate with presence of porosity. The same individual showed abnormal bone tissue formation, similar to a granular osteoma, on the subarcuate fossa of the petrous part in the left temporal bone (Figure 6.43). In addition, abnormal new bone formation, followed by surface porosity and osteophytes, were seen on the left calcaneus-talus joint and on the articular facets of the left tarsal bones.

Figure 6.43 Abnormal bone tissue formation on the subarcuate fossa of the petrous part in the left temporal bone. Old adult male from the Loreto Ap.-Cappuccini cemetery (T14PEEP2). Photo by the author.

6.6 Dental Microwear Surface Texture Analysis

Microwear surface texture analysis was performed on N = 33 individuals with one maxillary or mandibular molar suitable for microwear observation (Loreto Ap.-Cappuccini: N = 11, Moscufo-Via Petrarca: N = 7, Spoltore-Quagliera: N = 15). Sample information and obtained values are presented in Table 6.44.

Table 6.44 Sample information.

Individual	Tooth type	Sex	Age category	Complexity (Asfc)	Smc	Anisotropy (epLsar)	Texture Fill Volume (Tfv)
L T4C	LRM2	Unsexed	Young adult	1.05	0.500811	0.0014	21270.7
L T5C	LRM2	Ambiguous	Juvenile	1.54	0.496955	0.0043	18102.44
L T12	ULM2	Male	Young adult	1.88	0.501244	0.002	19761.9
L T15	LRM2	Probable female	Juvenile	1.21	0.496008	0.0064	4252.99
L T17	URM2	Probable female	Young adult	1.04	0.498324	0.009	27228.69
L T18	URM1	Female	Old adult	1.17	0.497065	0.0035	33500.12
L T39.1	ULM2	Male	Young adult	1.57	0.345652	0.0019	12784.81
L T40.1	URM2	Female	Middle adult	1.59	0.500408	0.0016	23712.57
L T41	LLm2	Unsexed	Child	1.01	0.34445	0.0088	40361.57
L T55.1	ULm1	Unsexed	Child	2.04	0.34445	0.0063	37770.89
L T33	URm2	Unsexed	Child	1.57	0.496008	0.0059	47720.38
M C3-1	LLM2	Male	Juvenile	4.02	0.496008	0.0038	39039.93
M C3	LLM1	Unsexed	Unknown age	3.56	0.496008	0.0027	34563.7
M T2	LRM2	Male	Young adult	2.31	0.34445	0.0049	48034.11
M T8	LRM2	Male	Young adult	2.65	0.34445	0.0023	51830.66
M T16	LLM1	Probable male	Middle adult	4.04	0.34445	0.0015	49747.21
M T21	URM1	Female	Juvenile	1.97	0.34445	0.0023	52929.5
M T24	ULM2	Female	Middle adult	1.15	0.496008	0.0028	43393.17
S T34	ULM2	Female	Middle adult	2.13	0.496008	0.0045	39116.21
S T5	URM2	Male	Juvenile	2.7	0.34445	0.0037	44001.25
S T6	URM2	Unsexed	Juvenile	2.52	0.464072	0.0078	58135.09
S T9	ULM2	Probable male	Juvenile	8.45	0.34445	0.0032	47812.97
S T10	ULM2	Probable male	Juvenile	3.59	0.34445	0.0051	41313.75
S T15	ULM2	Male	Young adult	2.23	0.34445	0.0033	40200.29
S T16	ULM2	Male	Young adult	1.59	0.34445	0.0053	38646.93
S T19	URM2	Probable male	Young adult	2.33	0.675122	0.0037	43753.79
S T20	ULM2	Female	Juvenile	1.57	0.675122	0.002	49709.04
S T21	URM1	Female	Old adult	1.88	0.34445	0.002	38918.6
S T22	ULM2	Male	Middle adult	3.77	0.34445	0.0016	35894.85
S T23	LLM2	Male	Middle adult	2.98	0.34445	0.0038	36066.21
S T24	URM2	Male	Young adult	3.96	0.34445	0.0023	49346.82
S T25	URM2	Female	Young adult	2.76	0.496008	0.0029	47914.77
S T28	URM2	Male	Young adult	2.43	0.34445	0.0058	45650.6

Data were analysed to see whether there were differences of complexity, anisotropy and texture fill volume values across cemeteries, and whether there were differences of complexity, anisotropy and texture fill volume values within sex and age category. Considering the small sample size statistical observations were not conducted within each cemetery. Microwear mean values are summarised in Table 6.45.

Table 6.45 Microwear mean values divided by cemeteries, age and sex category. SD = standard deviation.

	n	Complexity (Asfc)		Anisotropy (epLsar)		Textural Fill Volume (Tfv)	
		Mean	SD	Mean	SD	Mean	SD
TOTAL	33	2.29	0.98	0.0039	0.0021	38257.17	12420.08
Cemeteries							
Loreto Ap.-Cappuccini	11	1.43	0.35	0.0046	0.0028	26042.46	12848.28
Moscufo-Via Petrarca	7	2.82	1.10	0.0029	0.0011	45648.33	6896.32
Spoltore-Quagliera	15	2.70	0.82	0.0038	0.0017	43765.41	6102.84
Age groups							
Children	3	1.54	0.52	0.0070	0.0016	41950.95	5161.66
Juveniles	9	2.57	1.09	0.0043	0.0019	39477.44	17410.17
Young adults	12	2.15	0.81	0.0037	0.0022	37202.01	13391.33
Middle adults	6	2.61	1.18	0.0026	0.0013	37988.37	8725.02
Old adults	2	1.52	0.50	0.0028	0.0011	36209.36	3831.44
Unknown age	1	3.56	_	0.0027	_	34563.70	_
Sex							
Female	10	1.65	0.54	0.0037	0.0024	36067.57	14649.19
Male	16	2.88	0.90	0.0034	0.0014	40242.88	10633.61
Ambiguous	1	1.54	_	0.0043	_	18102.44	_
Unsexed	6	1.96	0.98	0.0055	0.0029	39970.39	12441.23

Data were checked for normal distribution. Values were first tested with no selected grouping variable in factor list. Results showed that complexity, anisotropy and texture fill volume values were not normally distributed. When cemetery, sex or age groups, were included in the factor list, data exhibited both normal and non-normal distribution. Graphical methods were also used to assess normality. Based on the visual observation, small and unequal sample size, nonparametric statistical tests were preferred over parametric. The individuals ST9 resulted an outlier for the complexity value (Asfc), therefore it was transformed by winsorization (from 8.45 to 4.04, the highest value within the sample).

Kruskal-Wallis test revealed that the complexity of microwear surfaces ($H = 15.777$, $p = 0.000$) and the texture fill volume ($H = 14.170$, $p = 0.001$) differed significantly across the cemeteries. In contrast, there was no significant difference in anisotropy across cemeteries (H = 1.632, p = 0.442). Bonferroni post-hoc test of pairwise mean differences indicates that individuals from Loreto Ap.-Cappuccini had a significant lower mean complexity values compared to the individuals from Moscufo-Via Petrarca (p = 0.008) and Spoltore-Quagliera (p = 0.001). No statistical significance was observed between individuals from Moscufo-Via Petrarca and Spoltore-Quagliera (p = 1.000). Similarly, individuals from Loreto Ap.-Cappuccini had significantly lower mean textural fill volume values compared to individuals from Spoltore-Quagliera (p = 0.004) and Moscufo-Via Petrarca (p = 0.003).

Microwear texture surface differences were compared between immature and adult individuals. Age categories were pooled to maximise the statistical outcome considering the small sample size. Mann-Whitney U test revealed that anisotropy differed between the age groups, with immatures showing higher mean anisotropy compared to adults (U = 61.000, p = 0.014), but complexity and texture fill volume did not (U = 124.000, p = 0.956 and U = 97.000, p = 0.291, respectively). The differences of anisotropy mean values between immatures and adults was also evident in the boxplot presented in Figure 6.44. The boxplot showed that there is much more variation of anisotropy values in the immature than in adult individuals.

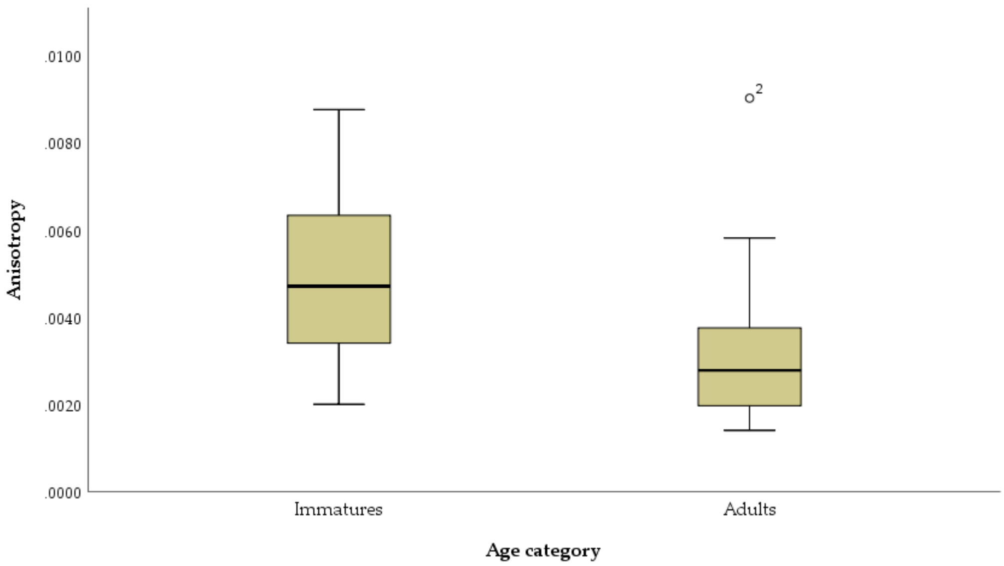

Figure 6.44 Boxplot of anisotropy between immature and adult individuals.

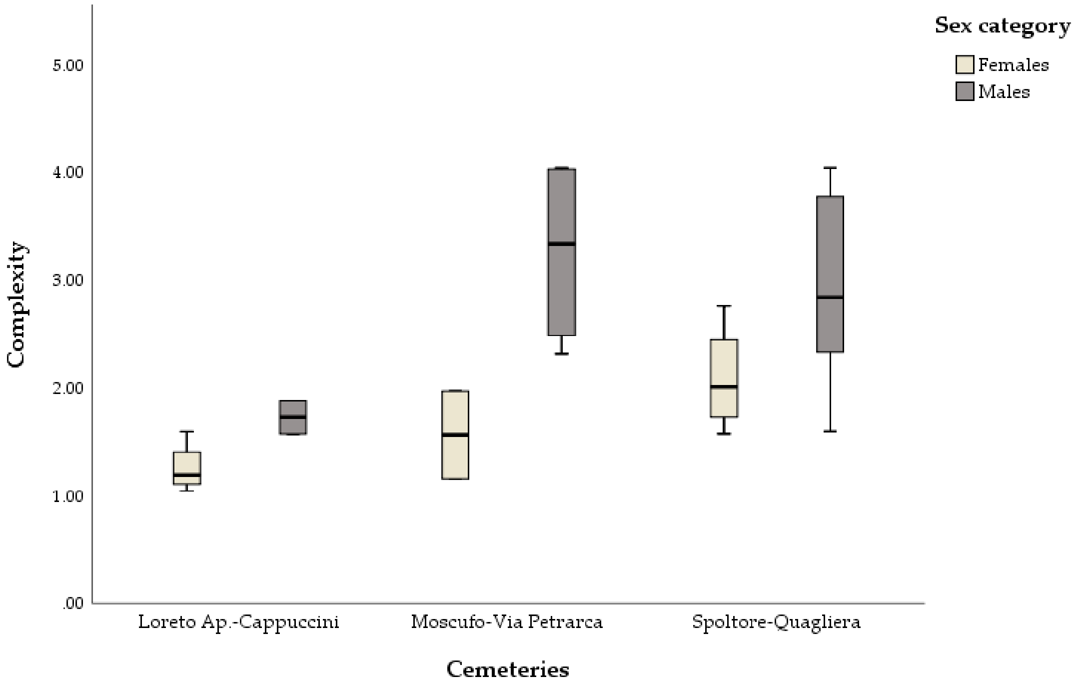

Figure 6.45 Clustered boxplot of complexity by cemeteries and sex.

Differences in mean values between sexes were statistically significant for the pooled sample only for the surface complexity (U = 141.000, p = 0.001), with females showing lower mean complexity than males. The clustered boxplot presented in Figure 6.45 showed the complexity values grouped by cemeteries and sex. The mean values of female and male individuals were not the same, this difference was maintained across cemeteries. Overall, the boxplot showed that there is little variation of complexity values in both female and male individuals from Loreto Ap.-Cappuccini and Moscufo-Via Petrarca. Greater variation of the values was observed in Spoltore-Quagliera.

Figure 6.46 showed the mean complexity and mean anisotropy values divided by age and sex categories across cemeteries. Adult males from Moscufo-Via Petrarca (A-M) and Spoltore-Quagliera (A-M) showed the highest complexity mean value, while the adult females (A-F) from Loreto Ap.-Cappuccini the lowest. Children (I-A) from Loreto Ap.-Cappuccini exhibited the lowest anisotropy mean value, however, the mean complexity was in the range of the adult males from Loreto Ap.-Cappuccini and the adults females from Moscufo-Via Petrarca. Overall, the scatter plot in Figure 6.46 showed that there was a clear distinction in the complexity mean across the cemeteries, and that the females and the children form Loreto Ap.-Cappuccini exhibited the lowest values.

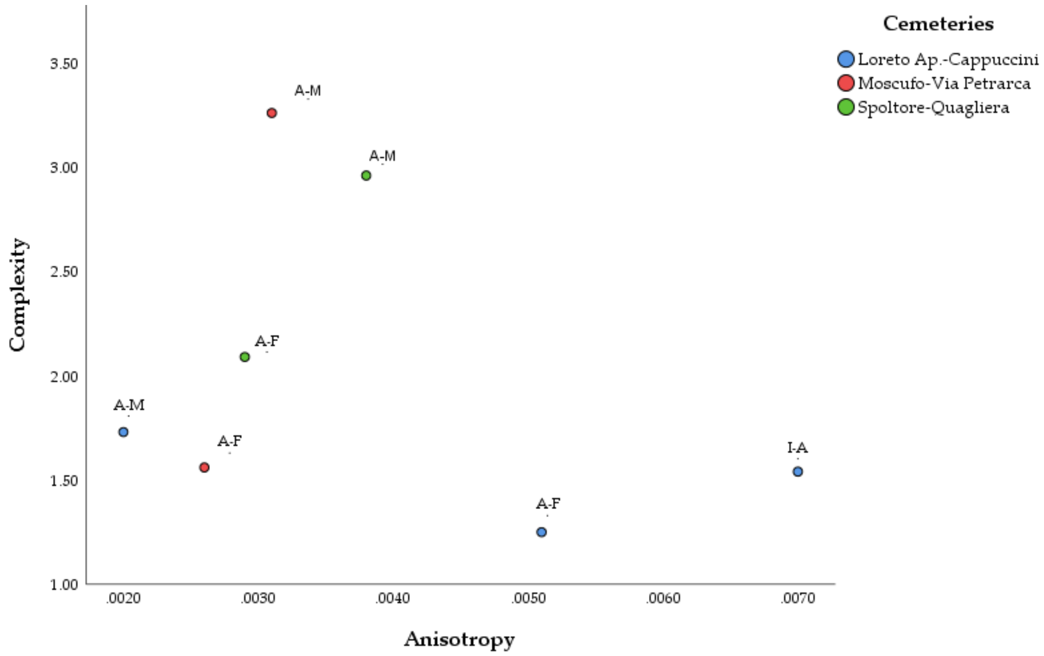

Figure 6.46 Scatter plot of complexity and anisotropy by cemeteries and filtered by age and sex. I-A = children unsexed; A-F = adults female; A-M = male.

6.7 Isotopes Results from the Loreto Aprutino-Cappuccini Cemetery

In the following sections the results of the isotope analyses for all individuals tested from the Loreto Ap.-Cappuccini cemetery are presented. Carbon and nitrogen isotope results are listed in section 6.7.1, while the results from the strontium isotope analysis are provided in section 6.7.2.

In spite of a large research on the reconstruction of paleodiet and mobility through isotope analyses on Italian contemporary sites, these techniques were never applied to study diet and mobility pre-Roman populations from Abruzzo. There is, therefore, a lack of comparative biosphere data. Regarding the analysis of paleodiet, two faunal remains found in two different burials located one in Loreto Ap.-Cappuccini (T43) and one in Moscufo-Via Petrarca cemeteries (box 4), were used in this study to have a rough estimation of the baseline to reconstruct the diet of the people buried at Loreto Ap.-Cappuccini. To investigate mobility and interpret the strontium signatures of human populations at Loreto Aprutino (section 6.7.2), it was also necessary to gauge the strontium isotope baseline of the Loreto Ap.-Cappuccini cemetery and the Abruzzo region. Due to the limited $^{87}Sr/^{86}Sr$ bioavailable data for the region under investigation, the strontium isotope baseline of the area was reconstructed combining published information on the geology of Abruzzo and Loreto Aprutino, published data on prehistoric horse and deer from nearby areas, and analysing modern flora specimens sampled in Loreto Aprutino.

6.7.1 Carbon and Nitrogen Stable Isotopes Results

The carbon and nitrogen isotope results are expressed with the delta (δ) notation, where the $^{13}C/^{12}C$ and $^{15}N/^{14}N$ ratios measured in the samples (Rsa) are normalised against those of international standards (Rst), according to the following:

$$\frac{Rsa - Rst}{Rst}\ x\ 10^3$$

$\delta^{13}C$ and $\delta^{15}N$ isotope values for human dentine (N = 16 individuals) from the Loreto Ap.-Cappuccini cemetery are showed in Table 6.46. $\delta^{13}C$ and $\delta^{15}N$ isotope values for animal bone from the Loreto Ap.-Cappuccini and Moscufo-Via Petrarca cemeteries are presented in Table 6.47. Data on C:N ratio and percent collagen were not measured due to the low amount of human dentine and animal bone sampled for the analysis.

Table 6.46 δ ^{13}C and $\delta^{15}N$ isotope values for tooth dentine from Loreto Ap.-Cappuccini cemetery.

Individual	Sex	Age	Tooth type	δ ^{13}C (dentine) ‰ VPDB	δ ^{15}N (dentine) ‰ AIR
T4CORO	Unsexed	20-26	LRM2	-20.5	8.1
T5CORO	Ambiguous	18-20	LRM2	-20.7	7.8
T7	Male	35-48	LRM2	-21.6	5.5
T8	Female	28-32	URM2	-22.0	8.6
T11	Male	40-50	LRM2	-20.2	8.9
T12	Male	30-35	ULM2	-21.0	9.0
T15	Female?	17-20	LRM2	-20.0	8.3
T17	Female?	30-35	LRM2	-21.2	8.1
T21	Unsexed	20-25	URM2	-23.0	8.8
T22	Male	33-44	ULM2	-19.5	9.5
T32	Female	18-20	URM2	-19.5	9.5
T31	Male	18-22	ULM2	-20.4	8.8
T39.1	Male	28-35	ULM2	-21.0	8.5
T39.2	Female	17-18	URM2	-22.1	8.9
T43.1	Female	50+	ULM2	-21.2	8.4
T40	Female	45-50	URM2	-19.6	8.0

Table 6.47 δ ^{13}C and $\delta^{15}N$ isotope values isotope values for bone collagen from fauna sample collected in Loreto Ap.-Cappuccini and Moscufo-Via Petrarca cemeteries.

Fauna	Location (archaeological site)	$\delta^{13}C$ (bone) ‰ VPDB	$\delta^{15}N$ (bone) ‰ AIR
Sheep/goat	Loreto Ap.-Cappuccini	-20.3	5.7
Unidentified	Moscufo-Via Petrarca	-15.3	5.9

The $\delta^{13}C$ values for human dentine range from -19.5‰ to -23.0‰ (mean: -20.8‰ ± 1.0‰); the $\delta^{15}N$ values range from 5.5‰ to 9.5‰ (mean: 8.4‰ ± 0.9‰). The $\delta^{13}C$ and $\delta^{15}N$ data for sheep/goat bone from the investigated site is -20.3‰ and 5.7‰ respectively, while the $\delta^{13}C$ and $\delta^{15}N$ data for the unidentified faunal bone from Moscufo-Via Petrarca cemetery are -15.3‰ (indicative of present of C_4 plant foods) and 5.9‰ respectively.

Figure 6.47 shows the distribution of values for human dentine and for animal bone. The pattern of the Loreto Ap.-Cappuccini isotopic data indicates the consumption of a terrestrial C_3 diet, with a possible small contribution of terrestrial C_4 plants. The mean $\delta^{15}N$ value for the humans is about 3‰ greater than that of the terrestrial herbivores analysed in this study. The nitrogen values are overall relatively low, with one individual (T7) exhibiting extremely low $\delta^{15}N$ ($\delta^{15}N$ = 5.5‰).

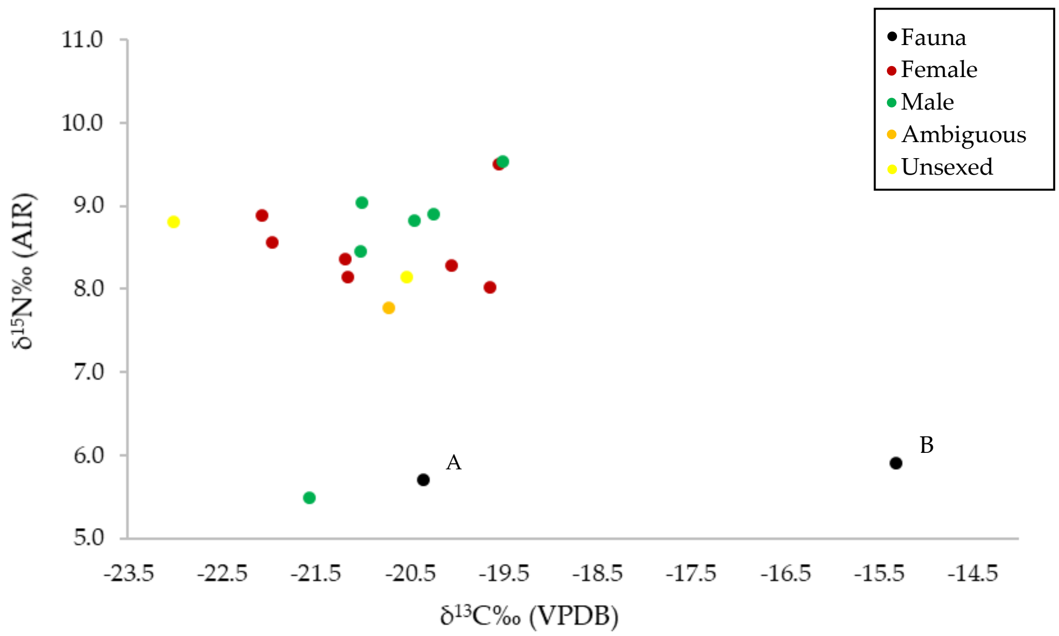

Figure 6.47 Graph of $\delta^{13}C$ and $\delta^{15}N$ value of human dentine buried at Loreto Ap.-Cappuccini, and faunal bones recovered in Loreto Ap.-Cappuccini (A) and Moscufo-Via Petrarca (B) cemeteries.

These data suggest a diet mostly based on foods at low trophic level, like legumes, during childhood and the absence of marine contribution. This interpretation will be addressed further in chapter 8. The $\delta^{13}C$ of the faunal remain from Loreto Aprutino (A) is in the range of the relative population. The moderately low $\delta^{13}C$ values relative to the humans suggest a low intake of terrestrial and marine animal proteins or dairy products. Of the N = 16 humans, seven are females, six are males, two are unsexed and one is of ambiguous sex. No significant difference was observed between the females $\delta^{13}C$ values and the males' ones (t = -0.347; p = 0.735). No significant difference was observed in $\delta^{15}N$ values between sexes (U = 27.000; p = 0.445). Both females and males sowed fundamentally similar $\delta^{13}C$ and $\delta^{15}N$ mean values.

6.7.2 Strontium Isotope Results

The strontium isotope ratios measured on human dental enamel of sixteen individuals from Loreto Ap.-Cappuccini are presented in Table 6.48. The $^{87}Sr/^{86}Sr$ ratios range from 0.70811 to 0.70990 with mean value of 0.708870 and a standard deviation of 0.000557.

Table 6.48 $^{87}Sr/^{86}Sr$ ratios of the individuals buried in Loreto Ap.-Cappuccini cemetery.

Individual	**Sex**	**Age**	**Tooth type**	**$^{87}Sr/^{86}Sr$ (enamel)**	**Sr 2SD (M)**
T4CORO	Unsexed	20-26	LRM2	0.708980	0.000014
T5CORO	Ambiguous	18-20	LRM2	0.709001	0.000070
T7	Male	35-48	LRM2	0.708517	0.000019
T8	Female	28-32	URM2	0.709295	0.000103
T11	Male	40-50	LRM2	0.708813	0.000025
T12	Male	30-35	ULM2	0.708105	0.000018
T15	Female?	17-20	LRM2	0.709521	0.000084
T17	Female?	30-35	LRM2	0.709074	0.000090
T21	Unsexed	20-25	URM2	0.708747	0.000015
T22	Male	33-44	ULM2	0.708166	0.000031
T32	Female	18-20	URM2	0.709899	0.000085
T31	Male	18-22	ULM2	0.709458	0.000173
T39.1	Male	28-35	ULM2	0.709098	0.000098
T39.2	Female	17-18	URM2	0.708651	0.000029
T43.1	Female	50+	ULM2	0.708398	0.000022
T40	Female	45-50	URM2	0.708210	0.000016

Table 6.49 shows $^{87}Sr/^{86}Sr$ ratios of a modern plant sample analysed as indication of the local bioavailable strontium signature. The sample, an oak leaf collected at 5.6 km radius of the Loreto Ap.-Cappuccini cemetery, yielded an $^{87}Sr/^{86}Sr$ value of 0.710206 ± 0.000064 (2SD). The distribution of the $^{87}Sr/^{86}Sr$ ratios of the individuals buried in Loreto Ap.-Cappuccini cemetery is presented in Figure 6.50 together with the $^{87}Sr/^{86}Sr$ values from rocks, vegetation, fauna, and natural mineral waters and groundwater of Abruzzo. As noted above, the reconstruction of the strontium isotope signature of the area in which the Loreto Ap.-Cappuccini cemetery and the surrounding territory are located is necessary in order to study mobility. For this reason, the scatterplot also includes $^{87}Sr/^{86}Sr$ values found in the literature that indicate the strontium isotope ranges for the Abruzzo region, as well as the $^{87}Sr/^{86}Sr$ value of the modern plant sample. These measurements are summarised in Table 6.49. Loreto Aprutino lies on a Periadriatic basin of marine and continental deposits of middle/late Pliocene and Pleistocene sedimentary units (Di Marcantonio, 2012). These units are primarily clayey deposits, formed by clay, marly grey-blue clay, and levels of sandstone, sand and conglomerates (Figure 6.48). Mineral water samples reflecting Tertiary and Quaternary sedimentary units (Cenozoic period) found in Voerkelius *et al.,* (2010), yielded an $^{87}Sr/^{86}Sr$ ratio ranging between 0.7090 and 0.7110. This range is used here to define the strontium signature of the area of Loreto Aprutino and is marked in the scatterplot with a dotted grey rectangle (Figure 6.50). Strontium isotope analysis on beach sand from Pescara, 30 km east of the Loreto Ap.-Cappuccini cemetery, yielded an $^{87}Sr/^{86}Sr$ value of 0.71112 ± 0.00010 (2SD) (Brems *et al.,* 2013). This datum is also included in the scatterplot to mark the local $^{87}Sr/^{86}Sr$ signature, as well as the $^{87}Sr/^{86}Sr$ value of the modern plant analysed in this study (0.710206 ± 0.000064 (2SD).

Almost half of the individuals buried in Loreto Ap.-Cappuccini (6 out of 16) fall within the dotted grey rectangle ($^{87}Sr/^{86}Sr$ range: 0.70901 - 0.71100). Of these, four are females (T8, T32, T17, T15) and two are males (T31, T39.1). Two of those individuals (T17, T39.1) also sit in the overlapping zone created between the $^{87}Sr/^{86}Sr$ ratios of mineral water from Cenozoic rocks and $^{87}Sr/^{86}Sr$ data of groundwater from the Gran Sasso massif. The Gran Sasso mountain chain is characterised by a complex geology composed of thrust sheets of Meso-Cenozoic sandstones and limestones (Miccadei *et al.,* 2011);

situated to the west of Loreto Aprutino (Figure 6.49). The groundwater of the Gran Sasso carbonate karst aquifer showed $^{87}Sr/^{86}Sr$ values between 0.70760 and 0.70920 (Barbieri *et al.*, 2005). The range is marked in the scatterplot with an orange two-way arrow (Figure 6.50). Ten individuals buried in the Loreto Ap.-Cappuccini cemetery (T11, T12, T21, T22, T39.2, T40, T43.1, T4CORO, T5CORO, T7) fall within this $^{87}Sr/^{86}Sr$ (0.7076-0.7092) range for Meso-Cenozoic rocks. Of these, three are females (T39.2, T40, T43.1), four are males (T11, T12, T22, T7), two are unsexed (T21, T4CORO) and one is of ambiguous sex (T5CORO). The low $^{87}Sr/^{86}Sr$ values of the buried individuals are also compatible with $^{87}Sr/^{86}Sr$ mean values for *Cervus elaphus* (0.70877) and *Equus hydruntinus* (0.70879) from Grotta di Pozzo, L'Aquila (about 110km radius of the Loreto Ap.-Cappuccini cemetery) found in Pellegrini *et al.* (2008). A statistical analysis was run to assess whether there was a statistically significant difference in $^{87}Sr/^{86}Sr$ values between female and male individuals buried in the Loreto Ap.-Cappuccini cemetery. The *t*-test for independent samples showed that there was no significant difference between sexes (t = 0.973; p = 0.351).

Table 6.49 Strontium Isotope ratio around Loreto Aprutino.

Geologic Era/Period	Type of data	Bedrock geology	$^{87}Sr/^{86}Sr$	$^{87}Sr/^{86}Sr$ mean	Sr 2SD (M)	$^{87}Sr/^{86}Sr$ range
Holocene	Pescara beach sand (Brems *et al.*, 2013)	Young beach deposits	0.71112	_	0.0001	_
Meso-Cenozoic	Gran Sasso massif Groundwater (Barbieri *et al.*, 2005)	Carbonate ridge	_	0.70840	0.00002	0.7076 - 0.7092
Tertiary and Quaternary	Natural mineral water Central Apennines (Voerkelius *et al.*, 2010)	Sedimentary units	_	0.7100	_	0.7090 - 0.7110
Holocene	Modern oak leaf (Loreto Aprutino)	Colluvial, alluvial, fluviolacustrine and young beach deposits	0.71008	_	0.00006	_
Meso-Cenozoic	*Cervus elaphus* Grotta di Pozzo (Pellegrini *et al.*, 2008)	Carbonate sequence (limestone)	_	0.70877	_	0.70871 - 0.70882
Meso-Cenozoic	*Equus hydruntinus* Grotta di Pozzo (Pellegrini *et al.*, 2008)	Carbonate sequence (limestone)	_	0.70879	_	0.70875 - 0.70888

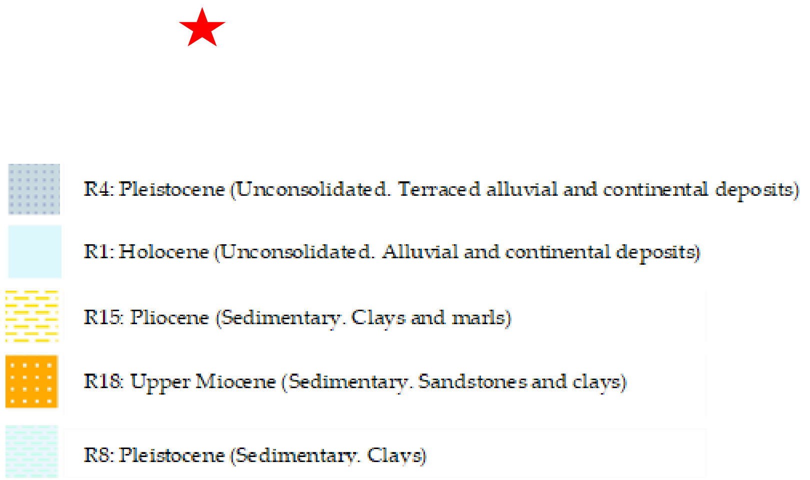

Figure 6.48 Detailed geology of Loreto Aprutino (from Geoportale Nazionale website).

Figure 6.49 Geological map of the central Apennine chain and the location of Loreto Aprutino (from Billi et al., 2006).

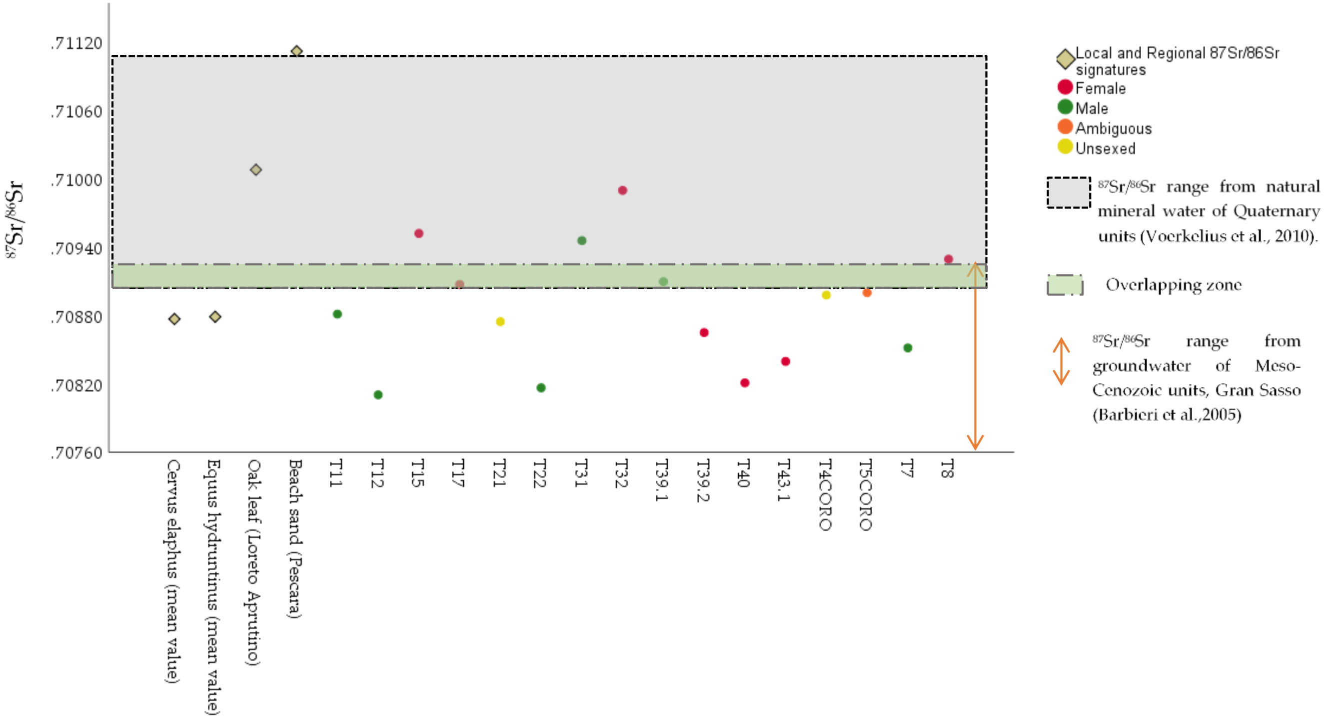

Figure 6.50 Strontium isotope ratio of the individuals from Loreto Ap.-Cappuccini cemetery together with the local and regional 87Sr/86Sr ratios signatures.

6.8 Summary Results

Indicators of physiological stress and diet observed within and between the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera cemeteries were presented in this chapter, as well as the isotopes data on diet and mobility of sixteen humans from Loreto Ap.-Cappuccini cemetery.

The mortality profile was not uniform across the cemeteries: high mortality among juveniles (12-20 years) was observed in the Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries, while high mortality of young adult individuals (20-30 years) was observed in the Loreto Ap.-Cappuccini and Spoltore-Quagliera samples, with a low prevalence of old adults, infants and children. The assemblage composition was principally equal in Loreto Ap.-Cappuccini, with similar numbers of female and male individuals, while an underrepresentation of females was noted in Moscufo-Via Petrarca and Spoltore-Quagliera. Sexual dimorphism in stature and body mass was statistically significant when the pooled sample was considered. Small differences were observed when cemeteries were considered separately, as in the case of Moscufo-Via Petrarca and Spoltore-Quagliera. At Moscufo-Via Petrarca, in particular, the stature between females and males varies slightly (5cm), while the body mass is equal.

Concerning the indicators of oral health, overall the individuals from Loreto Ap.-Cappuccini were experiencing high prevalence of dental pathologies, with males being more affected than females. However, females reported higher prevalence of antemortem tooth loss than males. Dental calculus was higher in the population from Spoltore-Quagliera compared to the other assemblages and juveniles and middle adults were the most affected. With regards to skeletal health, there was overall a low prevalence of infectious diseases across the three cemeteries. Less than 50% of the three populations were affected by endocranial lesions, sinusitis and cribra orbitalia. The highest percentage of people presenting cribra orbitalia was observed in the Loreto Ap.-Cappuccini cemetery. Osteoarthritis of the appendicular joints was relatively low within the three cemeteries. However, the individuals from Loreto Ap.-Cappuccini showed highest prevalence of cases, mainly on the ankle/foot complex, as well as on the wrist/hands and shoulder complexes. Spinal osteoarthritis was common across the three cemeteries, with the highest prevalence of observations at Loreto Ap.-Cappuccini. Males and females were generally equally affected by spinal osteoarthritis. Fracture and cranial lesions were also observed within the Loreto Ap-Cappuccini cemetery, but with low prevalence.

Diet was further examined using dental microwear texture analysis. The analysis revealed that there was a statistically significant difference in dental surface complexity values between the individuals from Loreto Ap.-Cappuccini and the ones from the other cemeteries. In addition, females exhibited lower mean surface complexity than male across the cemeteries. Significant difference was observed in complexity values between males and females within and across the cemeteries. When microwear texture surface differences were compared between immature and adult individuals, the Mann-Whitney U test revealed that anisotropy differed significantly between the age groups, with immatures showing higher mean anisotropy than adults. There was no significant difference between the age groups in mean complexity and texture fill volume.

Diet was also examined performing carbon and nitrogen isotopes analysis on the individuals of Loreto Ap.-Cappuccini cemetery. The isotopic data indicate consumption of terrestrial C_3 diet, with a possible small contribution of terrestrial C_4 plants. The nitrogen values are overall relatively low, with one individual (T7) exhibiting extremely low $\delta^{15}N$ ($\delta^{15}N = 5.5‰$). These data suggest a diet during childhood mostly based on foods at low trophic level like legumes, and the absence of marine contribution. No significant difference was observed between the females $\delta^{13}C$ values and the males' ones, and no significant difference was observed in $\delta^{15}N$ values between the sexes. The same sample of humans examined for carbon and nitrogen isotopes analysis was studied for mobility, using strontium isotope analyses. There is a possible evidence that two groups of individuals were probably buried in the Loreto Ap.-Cappuccini cemetery, only one of these seemingly local of the area. However, considering the small sample size and the lack of a complete bioavailable signature of the area, this result should be considered as preliminary.

Chapter 7 Results of Loreto Aprutino-Cappuccini, Moscufo-Via Petrarca, Spoltore-Quagliera, Pescara-Ex Gesuiti and Nocciano Burial Structures and Funerary Deposits

In this chapter the relationship between burial structures, funerary deposits and categories of age and sex is examined. It is necessary to highlight, however, that the absence of skeletal remains, due to taphonomy, excavation history and documentation could have limited the detailed interpretation of the materials and structures. The results presented in this chapter, therefore, might be subject to change should new studies on the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, Spoltore-Quagliera, Pescara-Ex Gesuiti, and Nocciano cemeteries be published.

Both the well-preserved burials and those lacking skeletal remains were considered for the analysis of the funerary context. In those cases where the biological sex could not be estimated, due to the lack of physical remains, burials were classified as 'No skeleton' (NS). When age at death was estimated, the individuals were grouped by age. Burials with skeletons that were not available to me for observation were classified as adults or immatures, based on the description provided in the archaeological reports.

7.1 Burial Structures

7.1.1 Adult Burials

Table 7.1 presents the description of the structures for adult burials in relation to the estimated biological sex. The results show that the majority of individuals were buried supine in simple *fossa* graves with no defined cover, with an *olla* placed on the intermediate level of the *fossa* (see Chapter 4). In Loreto Ap.-Cappuccini, however, nearly half of the female (40.0%) and male (45.5%) individuals were buried in a rectangular-type *fossa*. In the same cemetery, 90.0% of females had an *olla* half way up the wall of the burial pit, and in five burials the *olla* was enclosed with stones creating a niche. Similarly, an *olla* was in a niche on the intermediate level in 72.0% of male burials. Spoltore-

Quagliera and Nocciano showed differences in the burial structures compared to the other cemeteries. In Spoltore-Quagliera, female and male individuals were buried in a rectangular-shaped *fossa*, in a supine position with arms along the side of the body and legs out straight. Here, only one female (9.1%) had an *olla* on the intermediate level of the burial pit, compared to eight male burials (72.0%). The cemetery of Nocciano is the only site to reveal a different burial cover. 71.4% of the *fossae* were covered with slabs made of rough stone, and the *olla* was placed over them.

7.1.2 Juvenile Burials

The analysis of the burial structures of juveniles was conducted only on the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera cemeteries, due to the presence of skeletal remains with available diagnostic features for age estimation. From Table 7.2 it can be seen that juveniles from Spoltore-Quagliera were the only ones presenting a rectangular-shaped *fossa* grave (100.0%). All of the male individuals had an *olla* placed half way up the wall of the burial pit.

7.1.3 Infant and Child Burials

Table 7.3 shows that young individuals were buried in simple *fossa* graves. In the Nocciano cemetery, the graves of two immatures (100.0%) were covered with slabs, while in Loreto Ap-Cappuccini, only one grave was surrounded by large stones. Where present, an *olla* was positioned on the intermediate level of the burials, occasionally enclosed with stones creating a niche. In three immatures of unknown age, an *olla* was found on the floor of the burial pit.

Table 7.1 Prevalence rates of burial structures and body positions within adult age and between sexes, across cemeteries.

Cemetery	**Age category**	**Sex**	**N burials**	**Simple *fossa***	**Rectangular *fossa***	**Stone cover**	**Slab cover**	**Supine. Arms along the side, legs out straight**	**Supine. Left arm along the side, right arm bent on the pelvis**	**Supine. Right arm along the side, left arm bent on the pelvis**	**Supine. Arms and legs slightly flexed towards left**	**Supine. Both arms bent on pelvis**
Loreto Ap.-Cappuccini	Adult	Female	10	6 (60.0%)	4 (40.0%)	2 (20.0%)	_	7 (70.0%)	1 (10.0%)	2 (20.0%)	_	_
		Male	11	6 (54.5%)	5 (45.5%)	1 (9.1%)	_	9 (81.8%)	1 (9.1%)	1 (9.1%)	_	_
		Unsexed	4	3 (75.0%)	1 (25.0%)	1 (25.0%)	_	2 (50.0%)	_	_	_	_
		NS	21	13 (61.9%)	1 (4.8%)	_	_	5 (23.8%)	1 (4.8%)	1 (4.8%)	_	_
Moscufo-Via Petrarca	Adult	Female	4	4 (100.0%)	_	_	_	_	1 (25.0%)	_	_	2 (50.0%)
		Male	4	4 (100.0%)	_	_	_	2 (50.0%)	_	_	_	2 (50.0%)
		Unsexed	2	2 (100.0%)	_	_	_	1 (50.0%)	_	_	_	_
		NS	3	_	_	_	_	_	_	_	_	_
Spoltore-Quagliera	Adult	Female	11	_	11 (100.0%)	_	_	11 (100.0%)	_	_	_	_
		Male	11	_	11 (100.0%)	_	_	11 (100.0%)	_	_	_	_
Pescara-Ex Gesuiti	NS	NS	10	10 (100.0%)	_	_	_	1 (10.0%)	_	_	_	_
Nocciano	NS	NS	7	2 (28.6%)	5 (71.4%)	2 (28.6%)	5 (71.4%)	2 (28.6%)	1 (14.3%)	_	_	3 (42.9%)

Cemetery	**Age category**	**Sex**	**N burials**	***Olla* on deposition level**	***Olla* on intermediate level**	***Olla* under the deposition level**	**Niche**	**No *olla***
Loreto Ap.-Cappuccini	Adult	Female	10	_	9 (90.0%)	_	5 (50.0%)	1 (10%)
		Male	11	1 (9.1%)	8 (72.7%)	_	8 (72.2%)	1 (9.1%)
		Unsexed	4	_	2 (50.0%)	_	1 (25.0%)	_
		NS	21	1 (4.8%)	3 (14.3%)	_	_	7 (33.3%)
Moscufo-Via Petrarca	Adult	Female	4	1 (25.0%)	2 (50.0%)	_	1 (25.0%)	1 (25.0%)
		Male	4	1 (25.0%)	2 (50.0%)	_	_	1 (25.0%)
		Unsexed	2	_	1 (50.0%)	_	1 (50.0%)	_
		NS	3	_	1 (33.3%)	_	_	_
Spoltore-Quagliera	Adult	Female	11	_	1 (9.1%)	_	_	1 (9.1%)
		Male	11	_	8 (72.7%)	_	_	_
Pescara-Ex Gesuiti	NS	NS	10	6 (60.0%)	_	_	_	4 (40.0%)
Nocciano	NS	NS	7	3 (42.9%)	1 (14.3%)	2 (28.6%)	_	1 (14.3%)

Table 7.2 Prevalence rates of burial structures and body positions within juvenile age category and between sexes, across cemeteries.

Cemetery	**Age category**	**Sex**	**N burials**	**Simple *fossa***	**Rectangular *fossa***	**Stone cover**	**Slab cover**	**Supine. Arms along the side, legs out straight**	**Supine. Left arm along the side, right arm bent on the pelvis**	**Supine. Right arm along the side, left arm bent on the pelvis**	**Supine. Arms and legs slightly flexed towards left**	**Supine. Both arms bent on pelvis**
Loreto	Juvenile	Female	3	3 (100.0%)	_	_	_	2 (66.7%)	_	_	1 (33.3%)	_
Ap.-	(17-20)	Male	1	1 (100.0%)	_	_	_	1 (100.0%)	_	_	_	_
Cappuccini		Ambiguous	1	1 (100.0%)	_	_	_	1 (100.0%)	_	_	_	_
Moscufo-	Juvenile	Female	3	2 (66.7%)	1 (33.3%)	_	_	2 (66.7%)	_	_	_	1 (33.3%)
Via	(15-19)	Male	1	1 (100.0%)	_	_	_	1 (100.0%)	_	_	_	_
Petrarca		Unsexed	1	1 (100.0%)	_	_	_	_	_	1 (100.0%)	_	_
Spoltore-	Juvenile	Female	1	_	1 (100.0%)	_	_	1 (100.0%)	_	_	_	_
Quagliera	(12-22)	Male	5	_	5 (100.0%)	_	_	5 (100.0%)	_	_	_	_
		Unsexed	2	_	2 (100.0%)	_	_	2 (100.0%)	_	_	_	_

Cemetery	**Age category**	**Sex**	**N burials**	***Olla* on deposition level**	***Olla* on intermediate level**	***Olla* under the deposition level**	**Niche**	**No *olla***
Loreto	Juvenile	Female	3	_	_	_	_	3 (100.0%)
Ap.-	(17-20)	Male	1	_	1 (100.0%)	_	_	_
Cappuccini		Ambiguous	1	_	_	_	_	1 (100.0%)
Moscufo-	Juvenile	Female	3	_	3 (100.0%)	_	_	_
Via	(15-19)	Male	1	_	_	_	_	1 (100.0%)
Petrarca		Unsexed	1	_	1 (100.0%)	_	_	_
Spoltore-	Juvenile	Female	1	_	_	_	_	_
Quagliera	(12-22)	Male	5	_	5 (100.0%)	_	_	_
		Unsexed	2	_	_	_	_	1 (50.0%)

Table 7.3 *Prevalence rates of burial structures and body positions within the infant and child age category, across cemeteries.*

Cemetery	**Age category**	**N burials**	**Simple *fossa***	**Rectangular *fossa***	**Stone cover**	**Slab cover**	**Supine. Arms along the side, legs out straight**	**Supine. Left arm along the side, right arm bent on the pelvis**	**Supine. Right arm along the side, left arm bent on the pelvis**	**Supine. Arms and legs slightly flexed towards left**	**Supine. Both arms bent on pelvis**
Loreto Ap.-Cappuccini	1-2	1	1 (100.0%)	_	_	_	1 (100.0%)	_	_	_	_
	3-4	1	1 (100.0%)	_	1 (100.0%)	_	1 (100.0%)	_	_	_	_
	4-4	2	2 (100.0%)	_	_	_	2 (100.0%)	_	_	_	_
	5-6	1	1 (100.0%)	_	_	_	1 (100.0%)	_	_	_	_
	Immature	8	7 (87.5%)	_	_	_	4 (50.0%)	_	_	_	_
Moscufo-Via Petrarca	Immature	6	_	_	_	_	_	_	_	_	_
Spoltore-Quagliera	Immature	5	5 (100.0%)	_	_	_	_	_	_	_	_
	8-11	1	1 (100.0%)	_	_	_	_	_	_	_	_
Pescara-Ex Gesuiti	Immature	1	1 (100.0%)	_	_	_	_	_	_	_	_
Nocciano	Immature	2	2 (100.0%)	_	_	2 (100.0%)	_	_	_	_	1 (50.0%)

Cemetery	**Age category**	**N burials**	***Olla* on deposition level**	***Olla* on intermediate level**	***Olla* under the deposition level**	**Niche**	**No *olla***
Loreto Ap.-Cappuccini	1-2	1	_	_	_	_	1 (100.0%)
	3-4	1	_	_	_	_	1 (100.0%)
	4-4	2	_	1 (50.0%)	_	1 (50.0%)	1 (50.0%)
	5-6	1	_	1 (100.0%)	_	1 (100.0%)	_
	Immature	8	3 (37.5)	_	_	_	2 (25.0%)
Moscufo-Via Petrarca	Immature	6	_	_	_	_	_
Spoltore-Quagliera	Immature	5	_	1 20.0%)	_	_	_
	8-11	1	_	1 (100.0%)	_	1 (100.0%)	_
Pescara-Ex Gesuiti	Immature	1	_	_	_	_	1 (100.0%)
Nocciano	Immature	2	_	_	_	_	2 (100.0%)

7.2 Funerary Deposits

In the following sections, an overview of the funerary deposits from Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, Pescara-Ex Gesuiti and Nocciano cemeteries is presented. Five broad categories of grave goods were identified according to their typology and function. Each category of objects was analysed according to the age and sex of the deceased. The number of burials containing specific objects and the prevalence rates in percentages, within age and sex categories, were calculated and are presented below in the tables. The category of sex was not considered for infants and children.

7.2.1 Jewellery

7.2.1.1 Adult Burials

Table 7.4 and Figure 7.1 show the number of adult burials in which objects classified as 'jewellery' were part of the funerary deposits. Within the adult category, no males were buried with jewellery. Since no skeletal remains were available for the age and sex estimation from the Pescara and Nocciano cemeteries, the values included in Table 7.4 and Figure 7.1 could be representative of both sexes. The highest number of burials containing a necklace was observed in the Spoltore-Quagliera cemetery, where three females (27.3%) were inhumed with a necklace made of glass and bronze round beads, coral and bronze cylindrical beads, and bone, amber and stone beads. No adult individual was buried with necklaces or any other types of jewellery in the Moscufo-Via Petrarca cemetery, except for a probable female buried with a bronze and a limestone pendant. Pendants and beads seemed relatively common in the Nocciano cemetery, where 57.1% and 71.4% of individuals were inhumed with those ornaments. This type of accessory was less frequent in the other four cemeteries. In Loreto Ap.-Cappuccini, 11.0% of individuals were buried with pendants, three of them were females and two of unknown sex. Similarly, very few individuals were buried with pendants in Spoltore-Quagliera and Moscufo-Via Petrarca cemeteries. The armilla was also not a common object among adults; it was found in a female burial at Spoltore-Quagliera and with an individual of unknown sex at Pescara-Ex Gesuiti.

Table 7.4 Prevalence rates for jewellery within adult age category and between sexes, across cemeteries. NS = No skeletons available for observations.

Cemetery	Age category	Sex	N burials	Necklace	Isolated beads	Pendants	*Cypraea* shell	Circular disks	Torque	Diadem	Bracelet	*Armilla*
Loreto Ap.-Cappuccini	Adult	Female	10	1 (10.0%)	2 (20.0%)	3 (30.0%)	–	2 (20.0%)	–	–	–	–
		Male	11	–	–	–	–	–	–	–	–	–
		Unsexed	4	1 (25.5%)	2 (50.0%)	–	–	–	–	–	–	–
		NS	21	–	–	2 (9.5%)	–	–	–	–	–	–
Moscufo-Via Petrarca	Adult	Female	4	–	–	1 (25%)	–	–	–	–	–	–
		Male	4	–	–	–	–	–	–	–	–	–
		Unsexed	2	–	–	–	–	–	–	–	–	–
		NS	3	–	–	–	–	–	–	–	–	–
Spoltore-Quagliera	Adult	Female	11	3 (27.3%)	1 (9.1%)	2 (18.2%)	1 (9.1%)	1 (9.1%)	–	–	–	1 (9.1%)
		Male	11	–	–	–	–	–	–	–	–	–
Pescara-Ex Gesuiti	NS	NS	10	1 (10%)	2 (20%)	1 (10%)	1 (10%)	–	–	–	–	1 (10%)
Nocciano	NS	NS	7	1 (14.3%)	5 (71.4%)	4 (57.1%)	1 (14.3%)	2 (14.3%)	–	–	–	–

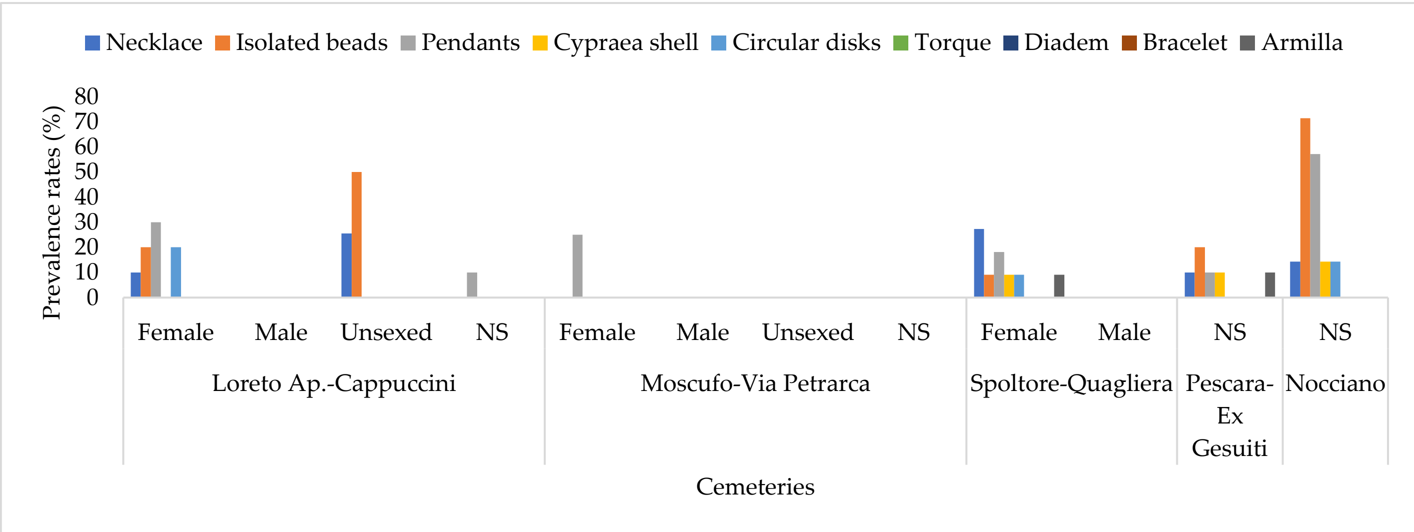

Figure 7.1 Prevalence rates for jewellery within adult age category and between sexes, across cemeteries.

7.2.1.2 Juvenile Burials

The cemeteries of Pescara-Ex Gesuiti and Nocciano were not included in this analysis because of the absence of skeletal remains, and the impossibility of estimating age at death. Table 7.5 and Figure 7.2 present the data relative to the list of jewellery types inhumed with juvenile individuals for whom age and sex were estimated. As for adults, juvenile males did not possess jewellery. In contrast, the practice of inhuming juvenile females with jewellery was visible at Loreto Ap.-Cappuccini and at Moscufo-Via Petrarca. At the former site, females were buried with glass paste beads (66.6%) and pendants (66.6%). A necklace made of glass paste and amber beads, two *Cypraea* shells and two bone circular disks, was also part of the jewellery set on the individual in burial T15 (17-20 years old). Two female individuals (66.6%) in the Moscufo-Via Petrarca cemetery were inhumed with a necklace made of cylindrical bronze elements, and pendants linked to iron fibulae. In contrast with the previous cemeteries, jewellery was totally absent in juvenile individuals from Spoltore-Quagliera.

7.2.1.3 Infant and Child Burials

The results relative to the distribution of jewellery among immatures are reported in Table 7.6 and Figure 7.3. The term 'immature' was used in the table when no skeleton was present for aging, and it refers to the classification that archaeologists used to define non-adult individuals. This distinction was done based on the dimensions of the burial pit. Overall, necklaces and isolated beads were the objects most commonly found in infant and child burials. Among the six immatures from Moscufo-Via Petrarca, two were inhumed with bracelets (33.3%) and four with *armillae* (66.7%). A diadem was observed in an immature burial from Spoltore-Quagliera, and it represents the only object of this kind found in the studied cemeteries.

Table 7.5 Prevalence rates for jewellery within juvenile age category and between sexes, across cemeteries.

Cemetery	Age category	Sex	N burials	Necklace	Isolated beads	Pendant	Cypraea shell	Circular disks	Torque	Diadem	Bracelet	Armilla
Loreto Ap.-Cappuccini	Juvenile (17-20)	Female	3	1 (33.3%)	2 (66.6%)	2 (66.6%)	1 (33.3%)	1 (33.3%)	_	_	_	_
		Male	1	_	_	_	_	_	_	_	_	_
		Ambiguous	1	_	_	_	_	_	_	_	_	_
Moscufo-Via Petrarca	Juvenile (15-19)	Female	3	2 (66.6%)	1 (33.3%)	2 (66.6%)	_	1 (33.3%)	_	_	_	_
		Male	1	_	_	_	_	_	_	_	_	_
		Unsexed	1	_	_	_	_	_	_	_	_	_
Spoltore-Quagliera	Juvenile (12-22)	Female	1	_	_	_	_	_	_	_	_	_
		Male	5	_	_	_	_	_	_	_	_	_
		Unsexed	2	_	_	_	_	_	_	_	_	_

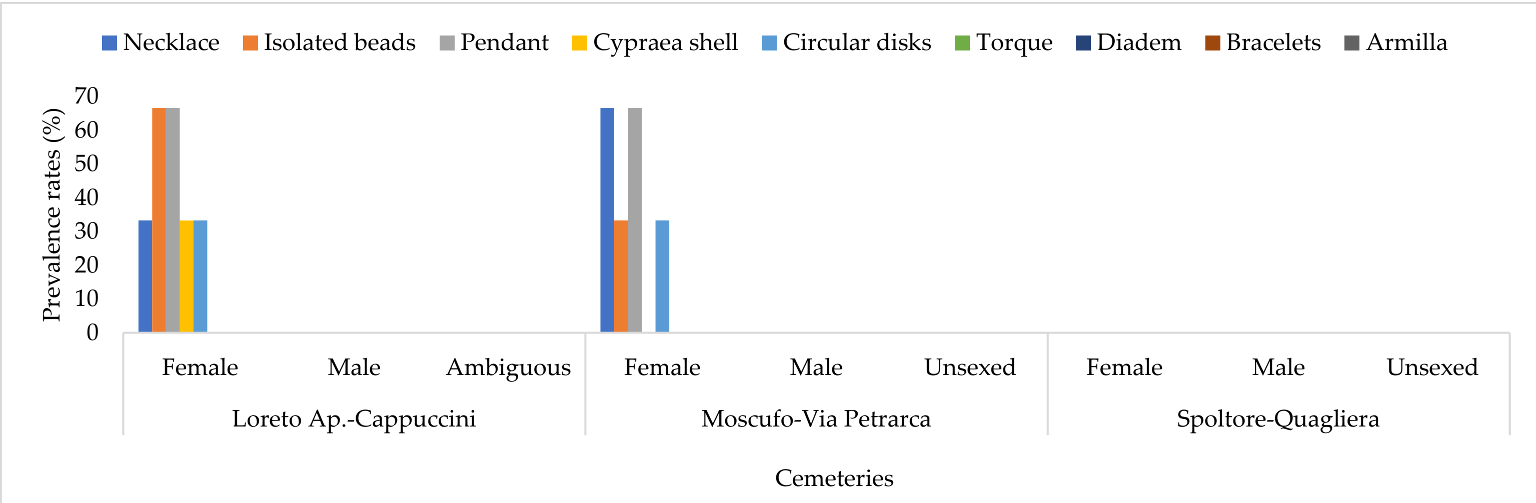

Figure 7.2 Prevalence rates for jewellery within juvenile age category and between sexes, across cemeteries.

Table 7.6 Prevalence rates for jewellery within infant and child age category, across cemeteries.

Cemetery	Age category	Sex	N burials	Necklace	Isolated beads	Pendants	Cypraea shells	Circular disks	Torque	Diadem	Bracelets	Armilla
Loreto Ap.-Cappuccini	1-2	Unsexed	1	_	1 (100.0%)	_	_	_	_	_	_	_
	3-4	Unsexed	1	1 (100.0%)	_	1 (100.0%)	_	_	_	_	_	_
	4-4	Unsexed	2	_	_	_	_	_	1 (100.0%)	_	_	_
	5-6	Unsexed	1	_	_	_	_	_	_	_	_	_
	Immature	Unsexed	8	2 (25.0%)	2 (25.0%)	2 (25.0%)	_	_	_	_	_	_
Moscufo-Via Petrarca	Immature	Unsexed	6	1 (16.7%)	1 (16.7%)	_	1 (16.7%)	_	_	_	2 (33.3%)	4 (66.7%)
Spoltore-Quagliera	Immature	Unsexed	5	1 (20.0%)	2 (40.0%)	2 (40.0%)	_	1 (20.0%)	1 (20.0%)	1 (20.0%)	_	_
	8-11	Unsexed	1	_	_	_	_	_	_	_	_	_
Pescara-Ex Gesuiti	Immature	Unsexed	1	1 (100.0%)	_	_	_	_	_	_	_	_
Nocciano	Immature	Unsexed	2	_	1 (50%)	_	_	_	_	_	_	_

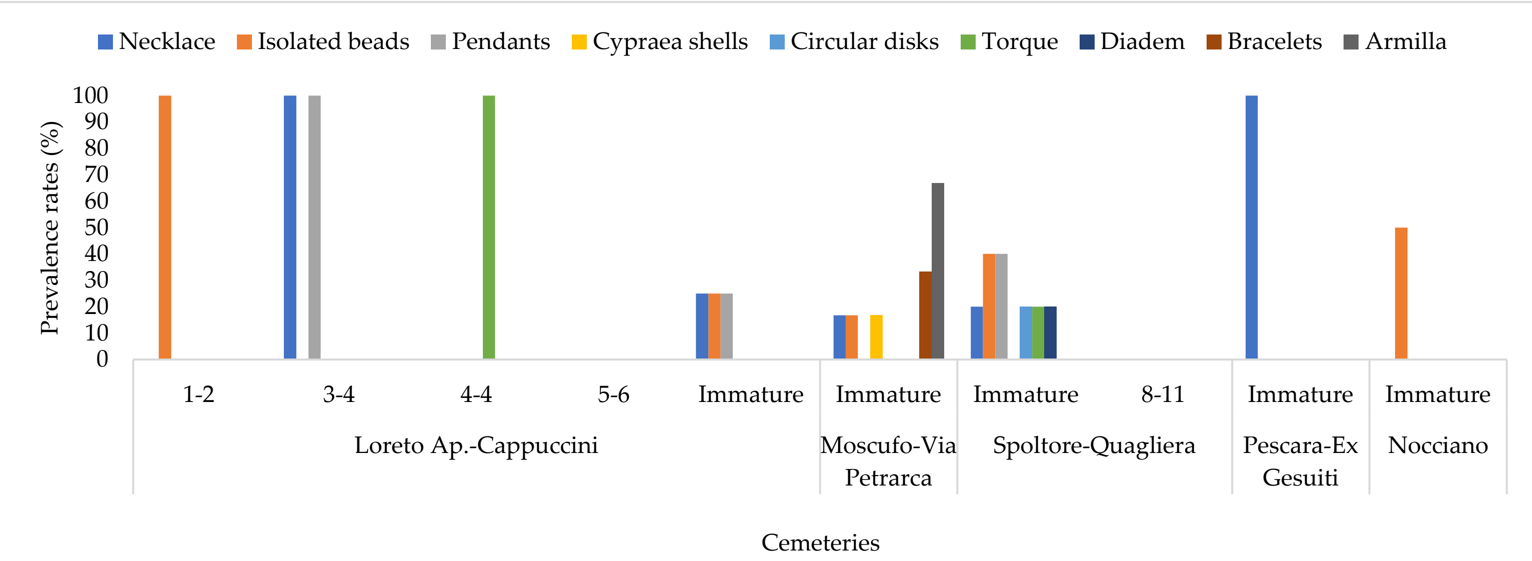

Figure 7.3 Prevalence rates for jewellery within infant and child age category, across cemeteries.

7.2.2 Jewellery-Materials

Figure 7.4 presents the materials used to manufacture jewellery items across categories of age in the cemeteries. The dominance of objects made of amber, glass paste, and bronze is clearly distinguishable. A few individuals were inhumed with objects made of coral and ivory in the Spoltore-Quagliera cemeteries. 33.3% of immatures had coral pendants linked to fibulae, while one adult female (9.1%) was buried with a necklace made of coral and bronze cylindrical beads, and two adult females (18.2%) with an ivory disk pendant and an ivory pin. Objects made of limestone were observed only with juvenile and adult female individuals at Moscufo-Via Petrarca.

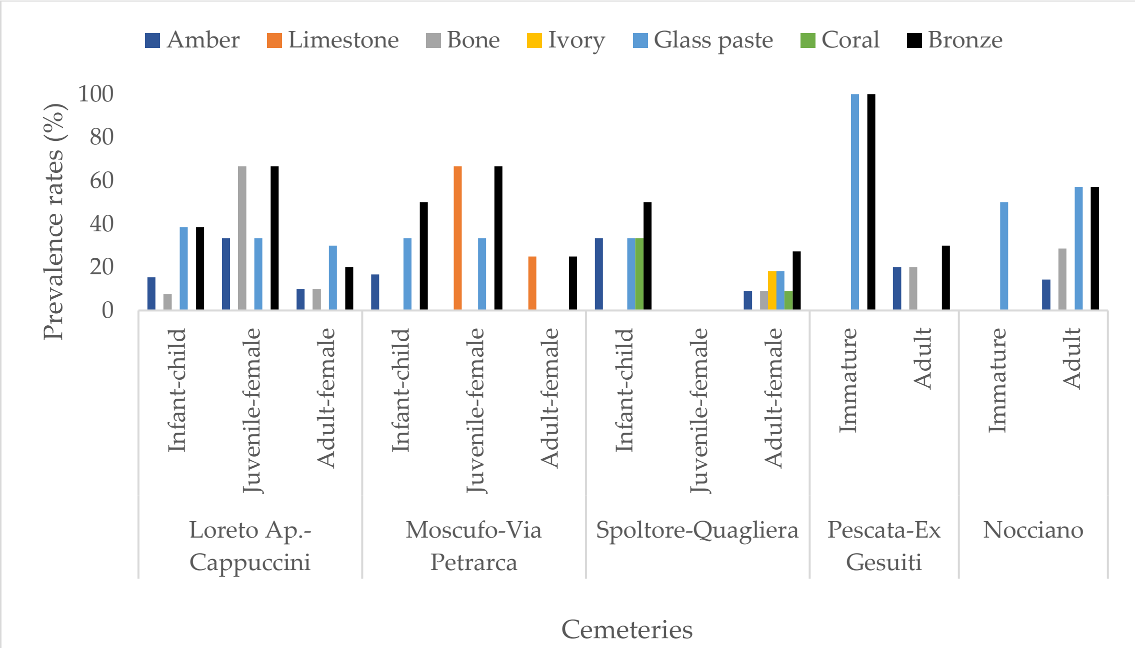

Figure 7.4 Materials used for jewellery and their prevalence rates within infant and female burials and across ages and cemeteries.

7.2.3 Dress Accessories

7.2.3.1 Adult Burials

The results of the analysis of functional and/or ornamental objects in adult burials in the five cemeteries are presented in Table 7.7 and Figure 7.5. Iron fibulae were the most common object among the adults from Loreto Ap.-Cappuccini, Pescara-Ex Gesuiti and Nocciano. When the estimated biological sex is considered, iron fibulae were found in only five male burials (45.5%) from Loreto Ap.-Cappuccini (Figure 7.5). In contrast, both bronze and iron fibulae were found in biologically female burials from Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera. In the latter cemetery, the number of females with bronze fibulae is higher than the number of females inhumed with iron fibulae, that is 27.3% and 9.1% respectively. At least one adult burial, within each of the studied cemeteries, displayed a long line of bronze rings. This accessory, present in six burials, was probably an element of dress adornment, perhaps sewn onto the fabric. In Loreto Ap.-Cappuccini and Spoltore-Quagliera, this object was part of the female burial assemblage.

7.2.3.2 Juvenile Burials

The distribution of dress accessories in juvenile burials is presented in Table 7.8 and Figure 7.6. Fibulae were found mainly in juvenile females, except for burial T30 at Spoltore-Quagliera where the fibulae belonged to a juvenile male individual. As for adults, the long line of bronze rings was found in four burials of juvenile female individuals, two from Loreto Ap.-Cappuccini (66.7%) and two from Moscufo-Via Petrarca (66.7%). Only one juvenile male individual was buried with a bronze belt in Spoltore-Quagliera (20.0%).

7.2.3.3 Infant and Child Burials

Dress accessories of infants and children from the studied sites are shown in Table 7.9 and Figure 7.7. Overall, bronze and iron fibulae were the only dress accessories found in infant and child burials, with iron fibulae being more common than the bronze ones.

Table 7.7 Prevalence rates for dress accessories within adult age category and between sexes, across cemeteries. NS = No skeletons available for observations.

Cemetery	Age category	Sex	N burials	Bronze Fibulae	Iron fibulae	Line of bronze rings	Belt	Shoes + crampons
Loreto Ap.-Cappuccini	Adult	Female	10	4 (40.0%)	5 (50.0%)	1 (10.0%)	_	_
		Male	11	_	5 (45.5%)	_	_	1 (9.1%)
		Unsexed	4	1 (25.0%)	1 (25.0%)	_	_	_
		NS	20	3 (15.0%)	6 (30.0%)	_	_	1 (5.0%)
Moscufo-Via Petrarca	Adult	Female	4	2 (50.0%)	2 (50.0%)	_	_	_
		Male	4	1 (25.0%)	_	_	_	_
		Unsexed	2	_	_	_	_	_
		NS	3	1 (33.3%)	1 (33.3%)	1 (33.3%)	_	_
Spoltore-Quagliera	Adult	Female	11	3 (27.3%)	1 (9.1%)	1 (9.1%)	_	_
		Male	11	_	_	_	_	_
Pescara-Ex Gesuiti	Adult	NS	10	2 (20.0%)	4 (40.0%)	2 (20.0%)	_	_
Nocciano	Adult	NS	7	2 (28.6%)	4 (57.14%)	1 (14.3%)	_	_

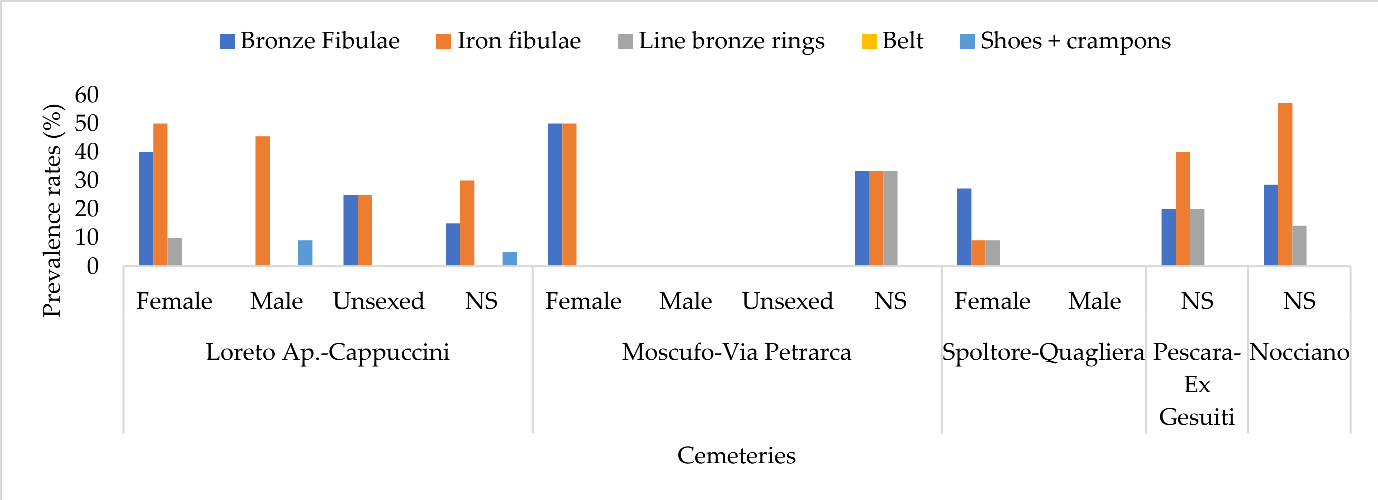

Figure 7.5 Prevalence rates for dress accessories within adult age category and between sexes, across cemeteries. NS = No skeletons available for observations.

Table 7.8 Prevalence rates for dress accessories within juvenile age category and between sexes, across cemeteries.

Cemetery	Age category	Sex	N burials	Bronze Fibulae	Iron fibulae	Line of bronze rings	Belt	Shoes + crampon
		Female	3	2 (66.7%)	3 (100.0%)	2 (66.7%)	_	_
Loreto Ap.-Cappuccini	Juvenile (17-20)	Male	1	_	_	_	_	_
		Ambiguous	1	_	1 (100.0%)	_	_	_
		Female	3	_	2 (66.7%)	2 (66.7%)	_	_
Moscufo-Via Petrarca	Juvenile (15-19)	Male	1	_	_	_	_	_
		Unsexed	1	_	_	_	_	_
		Female	1	_	_	_	_	_
Spoltore-Quagliera	Juvenile (12-22)	Male	5	_	1 (20.0%)	_	1 (20.0%)	_
		Unsexed	2	1 (50.0%)	1 (50.0%)	_	_	_

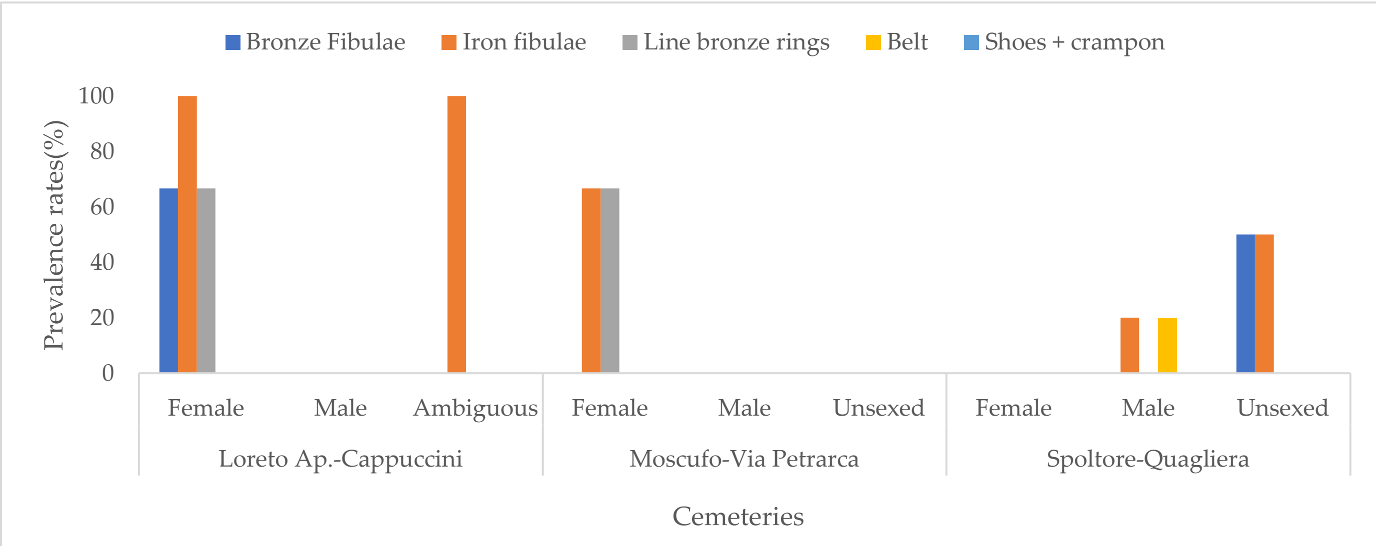

Figure 7.6 Prevalence rates jewellery within juvenile age category and between sexes, across cemeteries.

Table 7.9 Prevalence rates for dress accessories within infant and child age category, across cemeteries.

Cemetery	Age category	Sex	N burials	Bronze Fibulae	Iron fibulae	Line of bronze rings	Belt	Shoes + crampon
Loreto Ap.-Cappuccini	1-2	Unsexed	1	–	–	–	–	–
	3-4	Unsexed	1	–	1 (100.0%)	–	–	–
	4-4	Unsexed	2	–	1 (50.0%)	–	–	–
	5-6	Unsexed	1	1 (100.0%)	1 (100.0%)	–	–	–
	Immature	Unsexed	8	2 (25.0%)	4 (50.0%)	–	–	–
Moscufo-Via Petrarca	Immature	Unsexed	6	5 (83.0%)	5 (83.0%)	–	–	–
Spoltore-Quagliera	Immature	Unsexed	5	2 (40.0%)	–	–	–	–
	8-11	Unsexed	1	–	–	–	–	–
Pescara-Ex Gesuiti	Immature	Unsexed	1	1 (100.0%)	1 (100.0%)	–	–	–
Nocciano	Immature	Unsexed	2	1 (50.0%)	1 (50.0%)	–	–	–

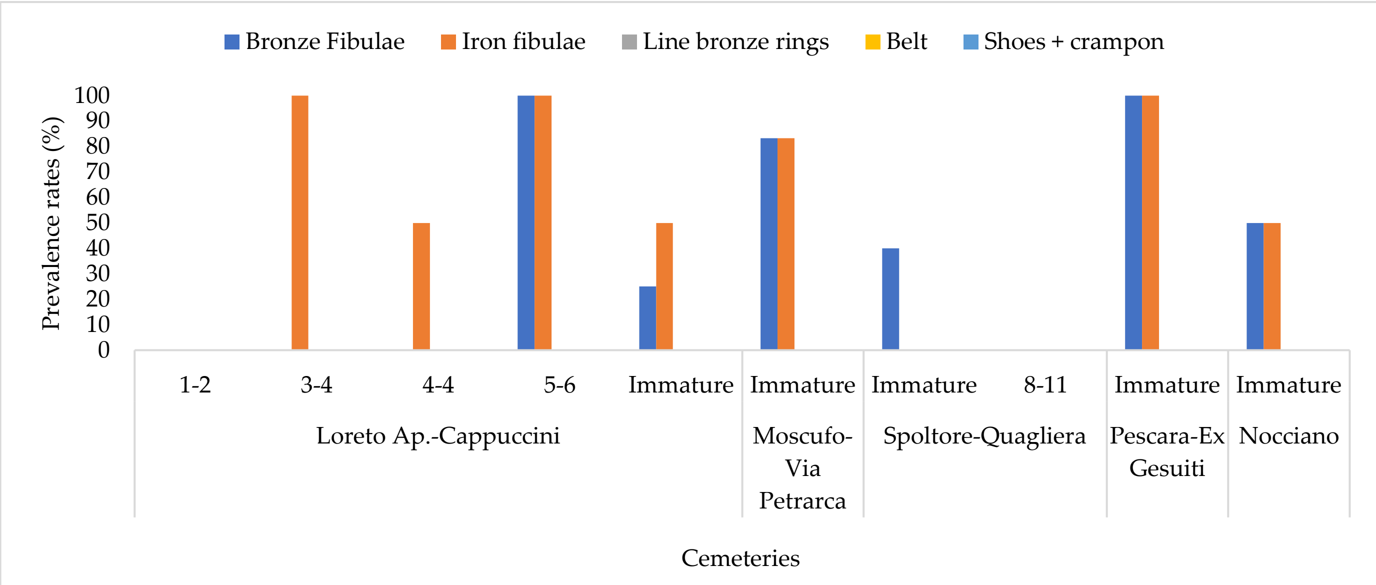

Figure 7.7 Prevalence rates for dress accessories within infant and child age category, across cemeteries.

7.2.4 Textile-Working Tools

7.2.4.1 Adult Burials

Table 7.10 shows the distribution of textile-working tools in adult burials in the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries. This study indicates that tools used for textile making were part of female assemblages, whereas they are absent in male burials. Half of the female individuals in Loreto Ap.-Cappuccini (50.0%) and Moscufo-Via Petrarca (50.0%) were buried with spindle-whorls. Other working tools for textile manufacture were present in female burials from Spoltore-Quagliera, such as the presence of four spindles made of lead.

Table 7.10 Prevalence rates for textile-working tools within adult age category and between sexes, across cemeteries. NS = No skeletons available for observations.

Cemetery	Age category	Sex	N burials	Needle	Spindle	Spindle-whorl	Reel
Loreto Ap.-Cappuccini	Adult	Female	10	_	_	5 (50.0%)	_
		Male	11	_	_	_	_
		Unsexed	4	_	_	_	_
		NS	20	_	_	_	_
Moscufo-Via Petrarca	Adult	Female	4	_	_	2 (50.0%)	_
		Male	4	_	_	_	_
		Unsexed	2	_	_	_	_
		NS	3	_	_	_	_
Spoltore-Quagliera	Adult	Female	11	1 (9.1%)	1 (9.1%)	1 (9.1%)	2 (18.2%)
		Male	11	_	_	_	_
Pescara-Ex Gesuiti	NS	NS	10	_	_	_	_
Nocciano	NS	NS	7	_	_	_	_

7.2.4.2 Juvenile, Infant and Child Burials

The results from Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, Spoltore-Quagliera, Pescara-Ex Gesuiti and Nocciano cemeteries show that tools for textiles production were absent in immature burials. In juvenile burials, spindle -whorls were present with a female individual from Loreto Ap.-Cappuccini (33.3%) and with a body of unknown sex from Moscufo-Via Petrarca (100.0%).

7.2.5 Conflict-Related Objects

7.2.5.1 Adult Burials

The set of combat-related objects found in the studied cemeteries is presented in Table 7.11 and Figure 7.8. Results show that no female individuals were buried with weapons or armour; in contrast, at least one male individual in each cemetery had a sword or a spearhead as part of his grave goods. More than half of the male burials in the Loreto Ap.-Cappuccini cemetery contained spearheads (54.4%), while swords were present in four male burials (36.4%). Lower percentages of males inhumed with swords and spearheads were observed in Spoltore-Quagliera (sword: 27.3%; spearhead: 27.3%) and in Nocciano (sword: 14.3%; spearhead: 14.3%). There is no evidence of a spearhead in the Moscufo-Via Petrarca cemetery.

Table 7.11 Prevalence rates for conflict-related objects within adult age category and between sexes, across cemeteries. NS = No skeletons available for observations.

Cemetery	Age category	Sex	N burials	Armour	Sword	Spearhead
Loreto Ap.-Cappuccini	Adult	Female	10	_	_	_
		Male	11	_	4 (36.4%)	6 (54.4 %)
		Unsexed	4	_	_	_
		NS	21	_	1 (4.8%)	1 (4.8%)
Moscufo-Via Petrarca	Adult	Female	4	_	_	_
		Male	4	_	2 (50.0%)	_
		Unsexed	2	_	2 (100.0%)	_
		NS	3	_	_	_
Spoltore-Quagliera	Adult	Female	11	_	_	_
		Male	11	_	3 (27.3%)	3 (27.3%)
Pescara-Ex Gesuiti	NS	NS	10	_	2 (20.0%)	2 (20.0%)
Nocciano	NS	NS	7	_	1 (14.3%)	1 (14.3%)

7.2.5.2 Juvenile, Infant and Child Burials

The burial goods of juvenile individuals do not differ particularly from the adult ones; females lack combat-related objects while young males were buried with a sword and/or a spearhead (Table 7.12). In Spoltore-Quagliera, the percentages of male individuals with a sword or a spearhead is lower than in Moscufo-Via Petrarca and Loreto Ap.-Cappuccini. What stands out in Spoltore-Quagliera cemetery is the presence of a piece of body armour, a *kardiophylax*, which is the only such object of this category found within the studied cemeteries. There was no evidence of offensive weapons buried with immature individuals, except for that of an 8-11-year-old child at Spoltore-Quagliera who had a spearhead.

Table 7.12 Prevalence rates for warlike objects within juvenile age category and between sexes, across cemeteries.

Cemetery	Age category	Sex	N burials	Armour	Sword	Spearhead
Loreto Ap.-Cappuccini	Juvenile (17-20)	Female	3	_	_	_
		Male	1	_	1 (100.0%)	1 (100.0%)
		Ambiguous	1	_	_	_
Moscufo-Via Petrarca	Juvenile (15-19)	Female	3	_	_	_
		Male	1	_	1 (100.0%)	_
		Unsexed	1	_	_	_
Spoltore-Quagliera	Juvenile (12-22)	Female	1	_	_	_
		Male	5	1 (20.0%)	1 (20.0%)	1 (20.0%)
		Unsexed	2	_	1 (50.0%)	_

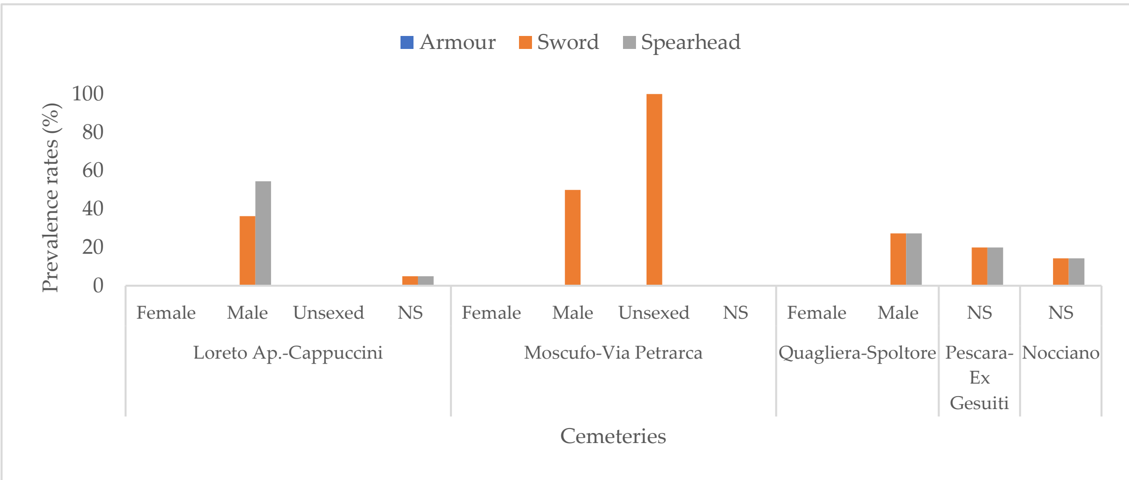

Figure 7.8 Prevalence rates for warlike objects within adult age category and between sexes, across cemeteries. NS = No skeletons available for observations

7.2.6 Food and Hygiene Related Metal Objects

7.2.6.1 Adult Burials

The distribution of metal objects linked to food and hygiene in adult burials is shown in Table 7.13 and Figure 7.9. Very few adult females were inhumed with objects related to personal hygiene. Tweezers were present in only two burials, one from Loreto Ap.-Cappuccini and one from Spoltore-Quagliera. In contrast, a razor was very common in male burials from the studied cemeteries. 63.6% of males in Spoltore-Quagliera had a razor, which also represents the highest prevalence rate among the five cemeteries. The ratio of males with a razor is lower at Loreto Ap.-Cappuccini than at Moscufo-Via Petrarca and Spoltore-Quagliera.

Iron spits, a bronze strainer (used as a filter for the poured wine), and knives/daggers are included in this group of artefacts. Such objects, associated with food preparation and consumption, were not displayed in female burials, as far as we can tell. Spits, which probably used for roasting meats, are very common in male burials at Loreto Ap.-Cappuccini where 72.7% of individuals were inhumed with this object. There were no spits in the Moscufo-Via Petrarca cemetery. The knife/dagger was a recurrent object found in relation to male burial goods, in particular, in the cemetery of Spoltore-Quagliera where 72.7% of males possessed one.

Table 7.13 Prevalence rates for food and hygiene metal objects within adult age category and between sexes, across cemeteries. NS = No skeletons available for observations.

Cemetery	Age category	Sex	N burials	Tweezers	Razor	Spit	Strainer	Knife/ dagger
Loreto Ap.-Cappuccini	Adult	Female	10	1 (10.0%)	_	_	_	_
		Male	11	_	4 (36.4%)	8 (72.7%)	_	2 (18.2%)
		Unsexed	4	_	_	_	_	_
		NS	20	_	_	2 (10.0%)	_	3 (15.0%)
Moscufo-Via Petrarca	Adult	Female	4	_	_	_	_	_
		Male	4	_	2 (50.0%)	_	_	_
		Unsexed	2	_	1 (50.0%)	_	_	_
		NS	3	_	_	_	_	_
Spoltore-Quagliera	Adult	Female	11	1 (9.1%)	_	_	_	_
		Male	11	_	7 (63.6%)	7 (63.6%)	_	8 (72.8%)
Pescara-Ex Gesuiti	NS	NS	10	_	2 (20.0%)	3 (30.0%)	_	_
Nocciano	NS	NS	7	_	1 (14.3%)	1 (14.3%)	_	1 (14.3%)

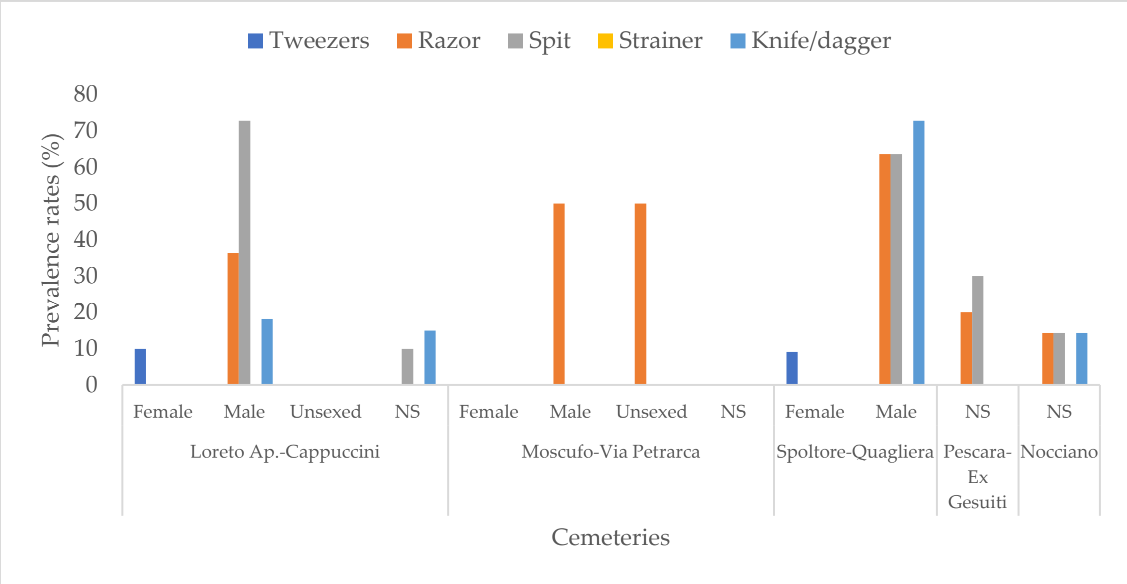

Figure 7.9 Prevalence rates for food and hygiene metal objects within adult age category and between sexes, across cemeteries. NS = No skeletons available for observations.

7.2.6.2 Juvenile, Infant and Child Burials

The ratio of metal objects relating to food and personal hygiene buried with juveniles is presented in Table 7.14 and Figure 7.10. What can be clearly seen in Figure 7.10 is the complete absence of those objects in male burials in the Loreto Ap.-Cappuccini and Moscufo-Via Petrarca cemeteries. The prevalence of inhumations containing the spit (80.0%) and the knife/dagger (60.0%), on the other hand, was decidedly high at Spoltore-Quagliera. In immature burials (Table 7.15 and Figure 7.11), the spit and the knife/dagger were seen only in Spoltore-Quagliera as part of the funerary deposits of an 8-11-year-old child. Common among infants and children were bronze tweezers. They were present in two burials from Loreto Ap.-Cappuccini (one belonging to a four-year-old child and one to an immature individual of unknown age), as well as in one immature inhumation at Moscufo-Via Petrarca and one at Pescara-Ex Gesuiti.

Table 7.14 Prevalence rates for food and hygiene metal objects within juvenile age category and between sexes, across cemeteries.

Cemetery	Age category	Sex	N burials	Tweezers	Razor	Spit	Strainer	Knife/ dagger
Loreto Ap.-Cappuccini	Juvenile (17-20)	Female	3	1 (33.3%)	–	–	–	–
		Male	1	–	–	–	–	–
		Ambiguous	1	–	–	–	–	–
Moscufo-Via Petrarca	Juvenile (15-19)	Female	3	–	–	–	–	–
		Male	1	–	–	–	–	–
		Unsexed	1	–	–	–	–	–
Spoltore-Quagliera	Juvenile (12-22)	Female	1	–	–	–	–	–
		Male	5	–	1 (20.0%)	4 (80.0%)	1 (20.0%)	3 (60.0%)
		Unsexed	2	–	1 (50.0%)	–	–	–

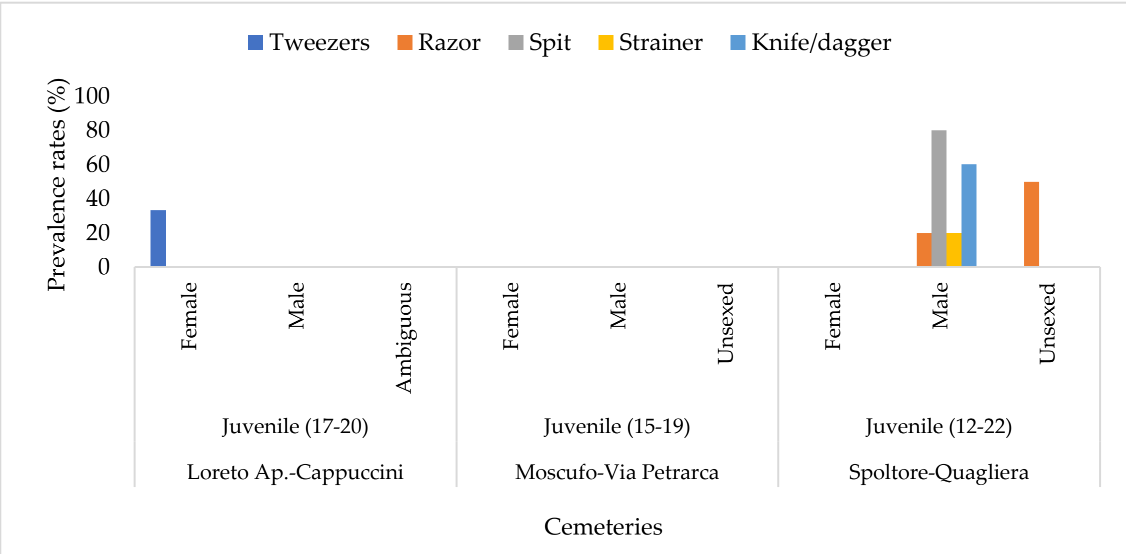

Figure 7.10 Prevalence rates for food and hygiene metal objects within juvenile age category and between sexes, across cemeteries.

Table 7.15 Prevalence rates for food and hygiene metal objects within infant and child age category, across cemeteries.

Cemetery	Age category	Sex	N burials	Tweezers	Razor	Spit	Strainer	Knife/ dagger
Loreto Ap.-Cappuccini	1-2	Unsexed	1	_	_	_	_	_
	3-4	Unsexed	1	1 (100.0%)	_	_	_	_
	4-4	Unsexed	2	_	_	_	_	_
	5-6	Unsexed	1	_	_	_	_	_
	Immature	Unsexed	8	1 (100.0%)	_	_	_	_
Moscufo-Via Petrarca	Immature	Unsexed	6	1 (100.0%)	_	_	_	_
Spoltore-Quagliera	Immature	Unsexed	5	_	_	_	_	_
	8-11	Unsexed	1	_	_	1 (100.0%)	_	1 (100.0%)
Pescara-Ex Gesuiti	Immature	Unsexed	1	1 (100.0%)	_	_	_	_
Nocciano	Immature	Unsexed	2	_	_	_	_	_

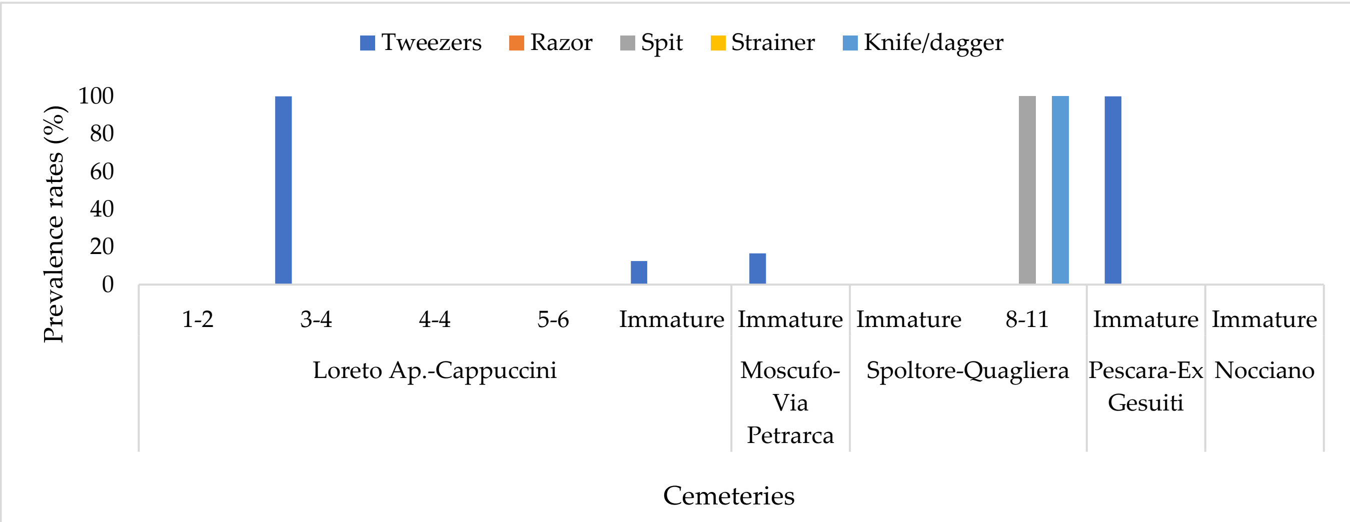

Figure 7.11 Prevalence rates for food and hygiene metal objects within infant and child age category, across cemeteries.

7.2.7 Ceramic and Metal Vessels

7.2.7.1 Adult Burials

The ceramic wares found in adult burials are presented in Table 7.16. Vessels were grouped in six broad categories, according to the function of the object. The *olla*, in the food/liquid container category, was present in at least one inhumation of the five cemeteries. The percentage of female and male burials with the *olla* do not differ consistently across cemeteries. An exception is the site of Spoltore-Quagliera, where the number of males inhumed with the *olla* (72.7%) is much greater than the number of females (18.2%). At Pescara-Ex Gesuiti and Nocciano, such observation cannot be done, due to the absence of skeletal remains available for sex estimation. Bronze cauldron, basically bronze basins with an iron handle, were present in four of the five cemeteries. In the Moscufo-Via Petrarca cemetery, a bronze bowl was included in the burial assemblage, instead of a cauldron.

Within the category of drinking vessels, cups were the most prevalent objects in the assemblages, principally in the Loreto Ap.-Cappuccini cemetery where more than half of female (60.0%) and males (81.8%) burials contained a cup. Black-glazed skyphoi with over-painted red palmettes from Greece were present with higher prevalence in both female (27.3%) and male (18.2%) burials at Spoltore-Quagliera. A Daunian 'mixed-styles' krater with lotus and palmettes and painted wares from Greece were also present in the Spoltore-Quagliera and Pescara-Ex Gesuiti cemeteries. None of the Daunian imports and Daunian-style objects were found in the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Nocciano cemeteries.

Table 7.16 Prevalence rates for pottery within adult age category and between sexes, across cemeteries. NS = No skeletons available for observations.

Cemetery	Age category	Sex	N burials	Food/liquid container				Drinking vessels			
				Olla	Small *olla*	Bronze cauldron	Bronze bowl	Cup	Small cup	*Kantharos*	*Skyphos*
Loreto Ap.-Cappuccini	Adult	Female	10	8 (80.0%)	4 (40.0%)	2 (20.0%)	_	6 (60.0%)	1 (10.0%)	_	_
		Male	11	9 (81.8%)	2 (18.2%)	_	_	9 (81.8%)	_	2 (18.2%)	1 (9.1%)
		Unsexed	4	2 (50.0%)	1 (25.0%)	1 (25.0%)	_	_	_	_	_
		NS	21	4 (19.0%)	2 (9.5%)	1 (4.8%)	_	5 (23.8%)	1 (4.8%)	1 (4.8%)	_
Moscufo-Via Petrarca	Adult	Female	4	3 (75.0%)	_	_	_	1 (25.0%)	_	_	_
		Male	4	3 (75.0%)	_	_	1 (25.0%)	_	_	_	_
		Unsexed	2	1 (50.0%)	1 (50.0%)	_	_	1 (50.0%)	_	_	_
		NS	3	2 (66.7%)	1 (33.3%)	_	_	2 (66.6%)	_	_	_
Spoltore-Quagliera	Adult	Female	11	2 (18.2%)	_	_	1 (9.1%)	2 (18.2%)	_	_	3 (27.3%)
		Male	11	8 (72.7%)	_	2 (18.2%)	1 (9.1%)	2 (18.2%)	_	_	2 (18.2%)
Pescara-Ex Gesuiti	NS	NS	10	6 (60.0%)	3 (30.0%)	2 (20.0%)	1 (10.0%)	7 (70.0%)	2 (20.0%)	_	_
Nocciano	NS	NS	7	5 (71.4%)	_	2 (28.6%)	_	_	_	_	_

Cemetery	Age category	Sex	N burials	Pouring container			Wine container		Attic wares	Other
				Olpe	Jug	*Oinochoe*	Amphora	Krater		
Loreto Ap.-Cappuccini	Adult	Female	10	_	4 (40.0%)	_	_	_	_	2 (20.0%)
		Male	11	2 (18.2%)	_	_	_	_	_	2 (18.2%)
		Unsexed	4	_	1 (25.0%)	_	_	_	_	1 (25.0%)
		NS	20	_	1 (5.0%)	_	_	_	_	3 (15.0%)
Moscufo-Via Petrarca	Adult	Female	4	_	2 (50.0%)	_	_	_	_	1 (25.0%)
		Male	4	_	_	_	_	_	_	1 (25.0%)
		Unsexed	2	_	_	_	_	_	_	_
		NS	3	_	3 (100.0%)	_	_	_	_	_
Spoltore-Quagliera	Adult	Female	11	_	3 (27.3%)	_	1 (9.1%)	1 (9.1%)	_	2 (18.2%)
		Male	11	_	1 (9.1%)	_	2 (18.2%)	_	1 (9.1%)	2 (18.2%)
Pescara-Ex Gesuiti	NS	NS	10	_	4 (40.0%)	_	2 (20.0%)	_	_	_
Nocciano	NS	NS	7	_	_	_	_	_	_	4 (57.1%)

7.2.7.2 Juvenile Burials

Table 7.17 presents the distribution of wares within the juvenile age category across the different cemeteries. What stands out is the low number of burials with vessels when compared to the adults, although the number of inhumations associated with juvenile individuals was anyway smaller than the number of adults. The *olla*, which was recurrent among adults of both sexes, here was present mainly in male inhumations. In contrast, at Moscufo-Via Petrarca, the *olla* was observed only in female burials (100.0%) and in one unsexed inhumation. Objects like the *kantharos*, *skyphos*, amphora and Attic wares were found in the juvenile burials at Spoltore-Quagliera.

7.2.7.3 Infant and Child Burials

The pottery assemblages of infants and children were characterised by drinking vessels and pouring containers (Table 7.18). Cups, handled cups, and jugs were the main objects given to immatures across the cemeteries. The large *olla* was observed in at least one burial within the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries. Two individuals (25.0%) in Loreto Ap.-Cappuccini were inhumed with the *kantharos* and one 5-6-year-old child with an amphora. A *skyphos* was found at Spoltore-Quagliera and at Nocciano.

Table 7.17 Prevalence rates for pottery within juvenile age category and between sexes, across cemeteries.

Cemetery	Age category	Sex	N burials	Food/liquid container				Drinking vessels			
				Olla	Small *olla*	Bronze cauldron	Bronze bowl	Cup	Small cup	*Kantharos*	*Skyphos*
Loreto Ap.-Cappuccini	Juvenile (17-20)	Female	3	_	_	_	_	1 (33.3%)	_	_	_
		Male	1	1 (100.0%)	_	1 (100.0%)	1 (100.0%)	1 (100.0%)	_	_	_
		Ambiguous	1	_	_	_	_	_	_	_	_
Moscufo-Via Petrarca	Juvenile (15-19)	Female	3	3 (100.0%)	_	_	_	_	_	_	_
		Male	1	_	_	_	_	_	_	_	_
		Unsexed	1	1(100.0%)	_	_	_	_	_	_	_
Spoltore-Quagliera	Juvenile (12-22)	Female	1	_	_	_	_	_	_	_	_
		Male	5	5 (100.0%)	_	2 (40.0%)	1 (20.0%)	_	_	1 (20.0%)	_
		Unsexed	2	_	_	1 (50.0%)	1 (50.0%)	_	_	_	2 (100.0%)

Cemetery	Age category	Sex	N burials	Pouring container			Wine container		Attic wares	Other
				Olpe	Jug	*Oinochoe*	Amphora	Krater		
Loreto Ap.-Cappuccini	Juvenile (17-20)	Female	3	_	_	_	_	_	_	_
		Male	1	_	_	_	_	_	_	_
		Ambiguous	1	_	_	_	_	_	_	_
Moscufo-Via Petrarca	Juvenile (15-19)	Female	3	_	2 (66.7%)	_	_	_	_	_
		Male	1	_	_	_	_	_	_	_
		Unsexed	1	_	_	_	_	_	_	_
Spoltore-Quagliera	Juvenile (12-22)	Female	1	_	_	_	_	_	_	_
		Male	5	_	_	_	1 (20.0%)	_	1 (20.0%)	2 (40.0%)
		Unsexed	2	_	1 (50.0%)	_	1 (50.0%)	_	_	1 (50.0%)

Table 7.18 Prevalence rates for pottery within infant and child age category, across cemeteries.

Cemetery	**Age category**	**Sex**	**N burials**	**Food/liquid container**				**Drinking vessels**			
				Olla	Small *olla*	Bronze cauldron	Bronze bowl	Cup	Small cup	*Kantharos*	*Skyphos*
Loreto Ap.-Cappuccini	1-2	Unsexed	1	_	_	_	_	_	_	_	_
	3-4	Unsexed	1	_	_	_	_	1 (100.0%)	1 (100.0%)	_	_
	4-4	Unsexed	2	_	1 (50.0%)	_	_	2 (100.0%)	_	_	_
	5-6	Unsexed	1	1 (100.0%)	_	_	_	1 (100.0%)	1 (100.0%)	_	_
	Immature	Unsexed	8	_	4 (50.0%)	_	_	5 (62.5%)	1 (12.5%)	2 (25.0%)	_
Moscufo-Via Petrarca	Immature	Unsexed	6	2 (33.3%)	_	_	_	1 (16.7%)	_	_	_
Spoltore-Quagliera	Immature	Unsexed	5	_	1 (20.0%)	_	_	_	_	_	1 (20.0%)
	8-11	Unsexed	1	1 (100.0%)	_	_	_	_	_	_	_
Pescara-Ex Gesuiti	Immature	Unsexed	1	_	_	_	_	1 (100.0%)	1 (100.0%)	_	_
Nocciano	Immature	Unsexed	2	_	_	_	_	_	_	_	1 (50.0%)

Cemetery	**Age category**	**Sex**	**N burials**	**Pouring container**			**Wine container**		**Attic wares**	**Other**
				Olpe	Jug	*Oinochoe*	Amphora	Krater		
Loreto Ap.-Cappuccini	1-2	Unsexed	1	_	_	_	_	_	_	_
	3-4	Unsexed	1	_	1 (100.0%)	_	_	_	_	_
	4-4	Unsexed	2	_	_	_	_	_	_	_
	5-6	Unsexed	1	_	1 (100.0%)	_	1 (100.0%)	_	_	_
	Immature	Unsexed	8	_	1 (12.5%)	_	_	_	_	_
Moscufo-Via Petrarca	Immature	Unsexed	6	_	2 (33.3%)	_	_	_	_	_
Spoltore-Quagliera	Immature	Unsexed	5	_	_	_	_	_	_	_
	8-11	Unsexed	1	_	_	_	_	_	_	1 (100.0%)
Pescara-Ex Gesuiti	Immature	Unsexed	1	_	1 (100.0%)	_	_	_	_	_
Nocciano	Immature	Unsexed	2	_	_	2 (100.0%)	_	_	_	_

7.2.8 Daunian Vessels

Excavations in the cemeteries of Spoltore-Quagliera and Pescara-Ex Gesuiti uncovered vessels that are reminiscent of pottery from Daunia, a region in neighbouring northern Apulia that was inhabited by the Italic Dauni. The list of objects classified by the excavators as probable Daunian is presented in Table 7.19. Three different decorative patterns were identified: concentric red bands, "mixed-styles" floral motifs, and refined floral decorations. Vessels with "mixed styles" floral motifs were present in the burials of infants, children, juveniles and adults at Spoltore-Quagliera and in two adult inhumations in the Pescara-Ex Gesuiti cemetery.

Table 7.19 Daunian-like wares in the Spoltore-Quagliera and Pescara-Ex Gesuiti cemeteries.

Cemetery	**Age category**	**Daunian-like ware**		
		Concentric red bands	**"Mixed styles" flora motifs**	**Refined floral decorations**
Spoltore-Quagliera	Infant-child		Pouring vessel decorated with floral and banded motifs (T2)	
	Juvenile		Pouring vessel decorated with floral and banded motifs (T6).	*Kantharos* with floral decorations (T30).
	Adult	Jug with simple concentric red bands (T25). Cup with red-banded painted decorations (T35). Small cup with red-banded painted decorations (T36).	Jug decorated with palmettes (T33). Poring vessel decorated with floral and banded motif (T36). Amphora with blackish floral motif (T35). Amphora blue and red colours with red bands (T34).	Krater with lotus and palettes decorations (T1).
Pescara-Ex Gesuiti	Infant-child	Jug and cup with simple banded decorations (T9)		
	Adult		Cup and jug with blue and red colours decorations (T2 and T6 respectively).	

7.3 Summary Results

This chapter has presented the results of the analysis of the data on burial structures and funerary deposits based on age and sex across the five studied archaeological sites. These results shed light on the status, role and identities of the populations inhabiting the central-east area of the Abruzzo region; further discussion of these topics will follow in chapter 8.

Few differences between the cemeteries were noticed through the analysis of the burial structures. Nocciano showed a unique coverage of burial pits consisting of large, rough-cult stone slabs; the large *olla*, when present, usually sits over the large slabs (see also Chapter 4). The burial typology, simple or rectangular, varies between the Loreto Ap.-Cappuccini and Moscufo-Via Petrarca cemeteries. However, at Spoltore-Quagliera all the inhumations were of rectangular shape. The inclusion of a large *olla* is fairly equally represented with both sexes in the Loreto Ap.-Cappuccini and Moscufo-Via Petrarca adult burials, whilst at Spoltore-Quagliera it was observed in only two female inhumations (see Chapter 4). A large *olla* positioned on the intermediate level of the burial was also evident in some of the inhumations of children.

Jewellery items were present only in the burials of infants, children, and adult females (when biological sex was estimated). In contrast, spits, knives/daggers, razors, swords, and spearheads were peculiar to the male assemblages, although not as highly prevalent as one might have expected. The textile working tools were part of the female sphere. Spindles, spindle-whorls, reels and needles were present in juvenile and adult individuals at Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera. These objects were indicators of the role of the owner, but they were also an important status symbol, when made of precious materials. The results of the analysis of pottery and metal vessels revealed that Daunian wares, some of them considered as Daunian imports, while others as local adaptation, were specific to the Spoltore-Quagliera and Pescara-Ex Gesuiti burial assemblages. At Spoltore-Quagliera these differences in burial structures, burial goods and materials, as indicators of roles, status, sex and identity will be further discussed in the following Chapter 8.

Chapter 8 Discussion

This thesis aimed to characterise the biological and socio-cultural variability in the populations who inhabited the hinterland and the lower Pescara valley in Abruzzo, to determine whether there were differences in diet, health, and identity among the different populations' groups. If differences were found, another aim was to understand how they differed and what inferences could be made to explain the possible reasons for such variability.

In the following sections the different strands of data and materials obtained and presented in Chapter 6 and Chapter 7 are discussed. The points of intersection between these data are considered, and an analysis through different scales, at the level of group of cemeteries, individual cemeteries, and individuals, is given for the selected research themes.

8.1 Demographic Profile and Funerary Practice of the Loreto Aprutino-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera Cemeteries

The demographic profiles of the populations considered in this study deviate from the standard mortality rate of pre-industrial populations. Overall, when skeletal remains are considered, a few cases of immature death were observed; at Loreto Ap.-Cappuccini and Spoltore-Quagliera there were very few individuals under the age of 12, while at Moscufo-Via Petrarca infants (birth – 3 years) and children (3 years – 12 years) were not represented. Across the three cemeteries, deaths predominantly occurred in the juveniles (12 years -20 years) and young adults (20 years - 35 years) age categories, with a low representation of old adults (50+ years). Published information on these cemeteries, however, highlighted that additional infant and child burials with no human skeletal remains were found (see Appendix B). In fact, the excavation reports indicated that a total of 13 infant burials were excavated at Loreto Ap.-Cappuccini, six at Moscufo-Via Petrarca, and six at Spoltore-Quagliera. In relation to this, there are two important points to consider: first, because of the absence of skeletal remains there is no possibility to assess with higher accuracy the infant age, which hinders a more thorough data interpretation; second, even if these burials were included in the calculation of the mortality rate of each cemetery, the representation of immatures would still be low.

The low mortality rate found in each of the three cemeteries analysed is in contrast with the evidence frequently seen for pre-industrial populations, where higher infant mortality rates are expected and recorded (Weiss, 1973; Chamberlain, 1997). Infant mortality can be caused by a series of conditions related to nutrition or malnutrition, infectious diseases, and conflicts. In the first years of life, the immune system is not completely developed, therefore neonates are more likely to be affected by infections, parasites, and other pathogens, which can result in a mortality peak (Goodman and Armelagos, 1989). The weaning process is another important phase concerning the survival of infants, as they start depending entirely on their own immune system (Katzenberg *et al.*, 1996). Weaning is considered a phase where a second peak of mortality and morbidity is frequently attested, after the neonatal phase (Goodman and Armelagos, 1989). Despite this, immatures were underrepresented in the three investigated cemeteries. In this context, the low number of immatures could be related to the poor preservation of the bones, for example infants and young individuals are more likely to be subjected to depositional changes or to an inaccurate excavation and recovery of the remains (Scheuer and Black, 2000a; Chamberlain, 2006; Lewis, 2007; Milner *et al.*, 2007). Nonetheless, such exceptionally low representation of immatures suggests that there may be other reasons. It is possible that the excavated cemeteries may represent sections of larger cemeteries that could have been reserved to a certain group of the society, or that more infants and children were buried in a different area of the cemetery not yet excavated (Carroll, 2018).

Low infant mortality was also observed in other cemeteries of Central-Southern Italy. At Satricum, a site located in the Lazio region dated 5th-4th centuries BC, the rate of infant mortality (comprising infants and children aged up to 9 years) was about the 20.7% of the total human skeletal remains analysed, and no death of neonates was recorded. In contrast, the main number of deaths was in what was defined as the juvenile-adult age (between 20-24 years and 25-29 years), while a decrease in mortality rate was observed from 30-35 years onwards (Rubini *et al.*, 2002). The immature age group was also underrepresented at Alfedena, a cemetery in southern Abruzzo, though the number of death at old age (50+ years) was higher (Rubini *et al.*, 2002). Interestingly, Rubini *et al.* (2002) argued that Alfedena and other sites of the Adriatic side differed from Satricum in terms of demographic profile. However, the mortality profile of Satricum, closely resembles the one of Loreto Aprutino-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera.

A slightly different pattern in infant mortality was observed in the cemeteries at Campovalano (Abruzzo), where a high mortality of immature individuals (comprising infants, children, and individuals aged up to 19 years) was recorded for the Orientalising-Archaic and Italic-Hellenistic phases. In both phases, mortality peaks within the immature individuals were observed in the age range that goes from birth to five years of age. Cesana (2016) suggested that the high mortality among immatures was a result of endogenous and environmental factors connected to changes in the population life conditions (Martellone, 2016). Similar to Campovalano, but with higher percentages of immature mortality rates, were the cemeteries at Navelli (inland Abruzzo, 7th-6th centuries BC) and at Pontecagnano-INA CASA (Campania, 8th-7th centuries BC). At Navelli, 70% of inhumations were of infants, children, and juveniles (Di Sabatino *et al.*, 2014a), whilst at Pontecagnano-INA CASA infant burials covered the 58% of the total (Bonaudo *et al.*, 2009). This discrepancy with the cemeteries at Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera could indicate a real difference in mortality rates, or it may be the evidence of different infant burial practices. The cemeteries of Campovalano (only Orientalising-Archaic phase), Navelli and Pontecagnano-INA CASA date back to earlier periods compared to the sites of Satricum, Alfedena, and the sites of focus in this thesis. The former cemeteries, therefore, might be representative of different funerary rituals taking place at these sites in the various periods of occupation. Other variables may have played an important role in determining the mortality profile of the individuals buried in the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries though, at present, there is no specific evidence that can lead to one or more hypothesis. These observations may not be representative of the entire population due to the small sample size, but they provide a starting point for future research focused on these populations inhabiting the middle Adriatic area. The similar number of females and males and mortality rate displayed anomalies. Complications during and after birth are considered one of the causes of death for women and, therefore, sex differences in mortality rates at a young age (Stone, 2016). However, this was not the case for the studied cemeteries, where it was observed a lower number of female individuals over the age of 20 and under the age of 50+ compared to males.

As far as the distribution of the burials at Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera cemeteries is concerned, no apparent recognisable pattern is clearly visible. Staffa (2003a) suggested that at Loreto Apr.-Cappuccini the burials were organised according to family ties. Studies of non-metric features of the Iron Age community of Alfedena Campo Consolino in Abruzzo, verified the existence of similarities within the groups of graves, and it was assumed that those similarities expressed the belonging to family groups (Coppa and Macchiarelli, 1982; Bondioli *et al.*, 1986; Rubini, 1996; Mogliazza and Rubini, 2003). Analysis of non-metric features would be necessary to confirm the hypothesis that also among the individuals buried in the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries there was strong evidence of endogamy. There is no evidence of grouping or exclusion systems based on age, sex or pathologies in any of the three cemeteries investigated. In fact, adults and immature burials all occupied the same space and there was a clear definition of the area with no burials overlapping, as for example seen at Pontecagnano-propriety Baldi (6th-5th centuries BC). At the latter site, infant burials were placed within enclosures, and other inhumations were placed in empty spaces with burials intersecting one another, without however damaging earlier burials (Pellegrino, 2004). In terms of the funerary rite, the three main cemeteries of focus in this thesis, along with the Pescara-Ex Gesuiti cemetery presented individual inhumations in *fossa* burials of anthropomorphic or rectangular shape. This funerary practice finds parallels with contemporary sites in Abruzzo such as Fossa (D'Ercole and Benelli, 2004), Bazzano (Weidig, 2014), Campovalano (Chiaramonte Treré, 2003; D'Ercole *et al.*, 2016), and in other sites of Central Italy (Di Niro, 1980, 1991; Bietti Sestieri, 1992; Rubini *et al.*, 2002). The cemetery of Nocciano, in contrast, differs in its use of limestone pieces to cover the burials, as observed at Alfedena Campo Cosolino (Parise Badoni and Ruggeri Giove, 1980).

The expression of social identity and social hierarchy within the populations from the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, Spoltore-Quagliera, Pescara-Ex Gesuiti, and Nocciano cemeteries is not clearly recognisable. At first glance, it seems that there was no obvious internal distinction within each community, and that all of the individuals were buried in the same cemetery regardless of gender, status, and age. The burial structures of adult individuals did not change considerably and the absence of the so called 'rich' burials leads to the conclusion that wealth was probably distributed among family members. The low hierarchical expression of society resembles the populations settled in southeast Samnium and along the Adriatic coast (Gnade, 1992; Norman, 2013; Delpino *et al.,* 2016; Scopacasa, 2016). Researchers who studied those populations suggested that the uniformity seen in the burials and the lack of cluster burials may represent an egalitarian community (Norman, 2013; Delpino *et al.*, 2016; Scopacasa, 2016). Subtle differences in funerary rituals among individuals and cemeteries are discernible, although they are limited and mainly restricted to age and gender through certain personal items (section 8.4.2). An important aspect that emerged from these cemeteries was that burial customs of infants and children were occasionally similar to those of adults. They were inhumed either in single burials amongst the adults or, exceptionally, included within an adult burial (e.g., Nocciano T3). It seems that many of the infants and children in the three main cemeteries might have occupied an active role within the community. This may be inferred from the presence of ceramic vessels, jewellery and ornaments in their burials, as will be discussed in the following sections. The attention paid to immature individuals, considering both the location of the burials and the funerary ritual, finds parallels in contemporary cemeteries such as those in Abruzzo (Campovalano, Bazzano, and Alfedena) (Parise Badoni and Ruggeri Giove, 1980; Weidig, 2014; D'Ercole *et al.,* 2016), in Latium (Satricum) (Gnade, 1992) and Campania (Potecagnano) (Cuozzo, 1998; Pellegrino, 2004; Bonaudo *et al.,* 2009).

8.2 Diet among the Individuals from the Loreto Aprutino-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera Cemeteries

8.2.1 Similarities and Differences in Diet Between Cemeteries and Their Effects on Individuals' Lives

Typically, there are several strands of data can be used to infer information on the dietary habits of ancient communities. To date, however, there is little palaeoethnobotanical and faunal evidence that provides data on the food economy and diet of the populations inhabiting the Abruzzo region during the 6th-4th centuries BC. Furthermore, the little environmental information available for this territory East of the Gran Sasso does not enable speculation as to precisely what food was consumed by these populations or the details of their economy in the 6th-4th centuries BC. In this thesis, analysis of dental pathologies, dental microwear texture analysis and stable isotope analysis were used to evaluate the dietary patterns of the middle Adriatic populations studied in this thesis and provide additional data to better understand the diet of these people. The dental analysis and microwear signatures from the three cemeteries indicate that these populations had a diet resembling one of farmers, with a mixed food intake that included high carbohydrate foods, vegetables, soft and hard food and meat. It was observed that there was a difference in diet between Loreto Ap.-Cappuccini and the other two cemeteries. The evidence that supports the hypothesis of different dietary patterns is presented below.

As observed in section 6.4, adult individuals from the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera cemeteries exhibited high levels of carious lesions (69.7%), dental calculus (65.8%), and periodontal disease (79.7%). Antemortem tooth loss was higher in Loreto Ap.-Cappuccini compared to the other cemeteries, and less than 50% of the individuals from the three cemeteries showed periapical lesions. The individuals from the Loreto Ap.-Cappuccini cemetery showed the highest prevalence rate of caries, and males exhibited more caries than females, although the difference is only 7% (Figure 6.5). The slightly lower prevalence of caries in females contrasts with the current research, where females tend to present higher prevalence in this regard than males (Lukacs and Largaespada, 2006). In fact, research found that hormonal fluctuation during puberty, menstruation, and pregnancy has an impact on the biochemical composition of the female saliva and its flow rate. This leads to changes in the oral environment, which becomes more cariogenic than the environment of male individuals (Lukacs and Largaespada, 2006). Females at Loreto Ap.-Cappuccini showed more antemortem tooth loss, which might have occurred as a consequence of severe caries. Dental caries may lead to a progressive destruction of enamel and dentine (Hillson, 1979; Ortner, 2003; Lukacs, 2018). It is possible, therefore, that females were more affected by caries than males, and that the lesions were severe enough to cause the loss of teeth during life (Hillson, 2001). An alternative possibility is that females were less prone to caries than males and that their antemortem tooth loss was due to factors other than caries, such as periodontal disease. These observations are particularly interesting when analysed together with the results of the dental microwear texture analysis.

The microwear results (section 6.6) showed that there were no statistically significant differences in the anisotropy values across the cemeteries. However, the population of the Loreto Ap.-Cappuccini cemetery differs in complexity and texture fill volume compared to Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries, which appeared to have similar microwear signatures. Overall, the individuals from the Loreto Ap.-Cappuccini cemetery showed lower complexity (Asfc = 1.43) and texture fill volume (Tfv = 26042.46) values compared to the others ($Asfc_{Moscufo}$ = 2.82, $Asfc_{Spoltore}$ = 2.70; $Tfv_{Moscufo}$ = 45648.33, $Tfv_{Spoltore}$ = 43765.41). This indicates that their diet included food that was softer than that of the populations from Moscufo-Via Petrarca and Spoltore-Quagliera. An explanation for this could be that foods having different textures were eaten (e.g., bread, cheese or legumes) by inhabitants of the three sites, and this might have mitigated the development of pitted surfaces as microwear features in the people of Loreto. Another possible explanation for the lower complexity could be that less grit particles were included in the food due to better food processing techniques (El-Zaatari, 2010; El Zaatari *et al.*, 2011).

Differences in microwear features were also observed between sexes, both within and between cemeteries. The microwear signature values suggest that the male individuals from Moscufo-Via Petrarca and Spoltore-Quagliera had a diet closer to that of foragers, showing high complexity ($Asfc_{Moscufo}$ > 3.00, $Asfc_{Spoltore}$ ~ 3.00). Future research could incorporate the use of other methods, such as, stable isotope analysis to confirm this hypothesis. Females showed overall lower mean complexity values than males, particularly if compared to males from Moscufo-Via Petrarca and Spoltore-Quagliera, and the difference in microwear was statistically significant across the cemeteries. These data suggest that in all sites females tended to have a different, probably softer diet than males. The adult females from Loreto Ap.-Cappuccini showed lower complexity but higher anisotropy values compared to all the other groups of adults. Thus, diet seems to have differed to some extent between the female individuals from Loreto Ap.-Cappuccini and those from Moscufo-Via Petrarca and Spoltore-Quagliera. The complexity and anisotropy features may indicate that the former ate less varied foods, and that meat was probably included in the diet as well as other types of fibrous foods. The high anisotropy of female individuals from Loreto Ap.-Cappuccini is an indicator of the consistent jaw movement during chewing. Schmidt *et al.* (2019) suggested that high anisotropy is linked with the homogeneous diets that distinguished populations of farmers. This diet results in persistent masticatory movements which form microwear features with similar orientation (Schmidt *et al.,* 2019). Interestingly, males from Loreto Ap.-Cappuccini exhibited higher mean complexity than females but much lower anisotropy, indicative of a low or absent consumption of tough and fibrous food. Similar considerations were also made by Remy and Schmidt (2016) in the case study of a number of Herculaneum individuals, where the values of anisotropy and complexity were respectively lower and higher for old males compared to females. In that context, the authors argued that the higher social status of those individuals allowed them to have better access to food, and to meat, in particular.

The individuals from the three cemeteries differ in terms of the prevalence rates of dental calculus. The population of the Spoltore-Quagliera cemetery exhibited the highest prevalence of calculus compared to the others. Dental calculus is the result of bacterial plaque mineralisation and mineralisation occurs when the pH of the saliva increases producing an alkaline environment in the mouth, which induces the precipitation of the phosphate from the saliva to the bacterial plaque (Waldron, 2009). The formation of dental calculus is related to diet, in particular with the consumption of dairy proteins and other food-related proteins (Hendy *et al.*, 2018). Studies show that the relationship between presence of calculus and caries is inverse because the former depends on mineralisation and the latter on demineralisation. This relationship is visible in the population of the Spoltore-Quagliera cemetery, which showed high prevalence of calculus (Table 6.15) and low prevalence rate of carious lesions (Table 6.9) and antemortem tooth loss (Table 6.25). Males exhibited higher prevalence rates for calculus than females, however the difference is not statistically significant. The increase in calculus with advancing age is not clearly visible, hence old adults presented the lowest rate. This may be explained by the high number of old individuals with antemortem tooth loss, which could have obscured this relationship. Overall, the oral environment of the Spoltore-Quagliera population appears to have been more affected by bacterial growth than the ones of the other cemeteries. Spoltore-Quagliera cemetery is located on the Abruzzo coast, therefore it is largely possible that the diet of its inhabitants comprised high consumption of proteins coming from legumes, fish and possibly meat. Zooarchaeological investigations from the site at Colle del Telegrafo (Bronze Age, early Iron Age), in Pescara, within a 5 km radius of Spoltore-Quagliera, uncovered evidence of dominance of cattle and domestic pig, as well as evidence of agriculturalism (De Grossi Mazzorin, 1998). Due to the cemeteries' proximity and geographical similarities, it is possible that a diet based on the same products characterised the Spoltore-Quagliera population.

As far as the microwear analysis is concerned, the complexity values found in the populations from Moscufo-Via Petrarca and Spoltore-Quagliera were considerably higher than those of Loreto Ap.-Cappuccini. In both cases, the values are similar to the mean complexity signatures of foraging populations, which commonly eat a variety of foods that are harder and less processed, creating a more pitted and course occlusal surface (Schmidt, 2001). In turn, anisotropy signatures are consistent with mean values found in farmers. It is possible that in the populations from Moscufo-Via Petrarca and Spoltore-Quagliera, either the breakdown of bone fragments during the consumption of protein sources or the consumption of seeds, nuts, fruits and hard food may have caused high surface complexity. Differences in diet between coastal (Isola Sacra) and inland (ANAS) cemeteries were also observed in the study carried out by Prowse *et al.*, (2004) using stable isotope analysis. Results showed, indeed, a different food intake between the sites. The isotopic composition from the individuals of the ANAS cemetery reflected a terrestrial-based diet, whilst the diet of the people form Isola Sacra was characterised by a mixed diet with a substantial component of marine foods, as well as terrestrial resources. A study conducted on hunter-gatherer populations from ecogeographically distinct zones found that, despite being meat eaters, these populations were subject to the ingestion of environmental abrasive particles (El-Zaatari, 2010; El Zaatari *et al.,* 2011; El Zaatari and Hublin, 2014). For example, the high level of complexity found in a population living near the sea was attributed to the ingestion of high abrasive particles, such as sand (Schmidt *et al.,* 2019). A similar explanation may be true for the population of the Spoltore-Quagliera cemetery. Spoltore-Quagliera is located 5 km from the coast of Pescara, hence it is likely that sandy particles and grits were involuntarily included in the food, for example during the consumption of fish and molluscs, or became part of it during food preparation (El Zaatari *et al.,* 2011).

The evidence discussed so far suggest that the three studied populations had a varied diet which also comprised meat, but it does not seem that any of the groups of males or females within the different cemeteries relied predominantly on meat. When the grave goods are considered, the presence of iron spits in the burials of male individuals at the Loreto Ap.-Cappuccini and Spoltore-Quagliera cemeteries was linked to the diet. It was suggested that the spits identified meat eaters, thus implying that male individuals were preferentially consuming meat (Staffa, 2010; Menozzi and Acconcia, 2017). However, this link between spits and male meat eaters is not supported by clear evidence and, in fact, the microwear signatures of both males and females from the Loreto Ap.-Cappuccini cemetery indicated the presence of meat in the diet, but they were not consistent with a heavily meat-based diet. At Spoltore-Quagliera, this association between the presence of spits and the consumption of meat is even more vague, as the complexity and anisotropy values indicated high consumption of hard food or the presence of grit/sand (associated with fish and molluscs) in foods. The variation in diet or food processing among the cemeteries was visible from the oral health and microwear analysis, though they did not seem to emerge from the grave goods. Additional surface texture analysis of other Iron Age and pre-Roman populations inhabiting the Abruzzo

Region would be necessary to contextualise and better interpret the results obtained from the study of the populations buried at Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries.

8.2.2 Variations in Dietary Patterns with Age

In order to assess whether there was a change in diet dependent on age, dental analysis and microwear signatures from the three cemeteries were observed. Generally speaking, a strong relationship between caries and age is often found (Hillson, 2001). However, the link between increasing prevalence of caries and increasing age is not always visible across the three main cemeteries investigated in this thesis. High prevalence of caries was observed among the young adults (100.0%, 11/11) and old adults (100.0%, 5/5) at Loreto Ap.-Cappuccini, while at Spoltore-Quagliera the middle-age category (35-50 years) was the most affected one (Table 6.9).

Infants and children were not represented at Moscufo-Via Petrarca and only one child was inhumed at Spoltore-Quagliera. A restricted number of infants and children were excavated from Loreto Ap.-Cappuccini, which allowed a more complete evaluation of variations in diet over the course of the individuals' lives. To achieve this purpose, analysis of dental pathologies and microwear signatures, along with stable isotope analysis, were analysed and discussed together. At Loreto, a low rate of caries and other dental pathologies were found in infants and children, which may be explained as a consequence of fewer teeth available for observations. A more reliable explanation is that the teeth of infants and children have a shorter time of exposure to destroying factors, such as high consumption of carbohydrates, compared to adults' teeth. The microwear signatures of the children from this cemetery show that the mean complexity values are similar to those of the children at Herculaneum (Remy and Schmidt, 2016; Kelly *et al.*, 2020), while the anisotropy values differ considerably from both the children at Herculaneum. Similar complexity values were also detected by Mahoney *et al.* (2016) in children aged between 4 and 6 years from Medieval England (Canterbury). By comparing the microwear features of children of different ages, Mahoney *et al.*(2016) argued that the diet of children in this age group possibly changed because of a variation in their mobility due to longer time spent in the company of adults, which might have resulted in more access to staples more typical of an adult diet (e.g., meat and vegetables). These complexity values suggest that children were consuming a range of foods that included hard and abrasive items. The very high mean anisotropy value (epLsar = 0.0070) observed in children of 3-4 years of age from Loreto Ap.-Cappuccini, differs considerably from the anisotropy values recorded at Herculaneum (epLsar between 0.0035 and 0.0045) and at Canterbury (epLsar = 0.0033). These anisotropy values from children at Loreto Ap.-Cappuccini indicate that their microwear features were organised, meaning that their jaws consistently moved in fewer directions. A diet comprising tough food may explain these microwear signatures, again highlighting the variation in food consumption compared with that of other individuals from Loreto Ap.-Cappuccini.

In contrast to dental pathologies, associated to various stages of individuals' lives, and from microwear features, which provide information on diet of the individuals in days of weeks preceding their death (Grine, 1986; Teaford and Tylenda, 1991), isotope analysis of dental enamel enables researchers to reconstruct diets at the time of dental development. Therefore, by comparing the data of the different analyses, it is possible to evaluate if there were variations in diet between children, juveniles and adults. The stable isotope values ($\delta^{13}C$) from the dentine of the sixteen adult individuals of the Loreto Ap.-Cappuccini cemetery indicate that at the time of their M2 (second molar) development, these individuals consumed a diet comprising primarily terrestrial C_3 plants such as wheat and barley, with a small contribution of terrestrial C_4 plants, probably millet. The low levels of $\delta^{15}N$ values suggests a diet mostly based on foods at low trophic level, like legumes, and the absence of marine food. One individual (T7) appeared to have had a diet absent of animal or marine protein but probably rich in legumes (e.g., lentils), cereals, and vegetables during childhood and adolescence, as highlighted by extremely low stable nitrogen value ($\delta^{15}N$). This result appears to be consistent with the microwear signatures found on the dental occlusal surface of children from Loreto Ap.-Cappuccini cemetery. The hypothesis of a diet rich in cereals, roots, nuts and legumes and low in animal proteins is in line with the archaeological evidence available from Abruzzo. Archaeological research of Bronze Age and Early Iron Age sites in the area of the Lake Fucino (inland Abruzzo) have returned evidence of hard wheat (Triticum durum), millet, barley and oat (Avena sativa) as well as fava bean, olives, and hazelnuts (Cosentino and Pellegrini, 2003; Shelton, 2009). It likely that these cereals and legumes were cultivated in the area of Loreto Ap.-Cappuccini, and equally likely that the population inhabiting this area ate this type of food. Data from carbon and nitrogen isotope analyses also highlighted that there was no statistically significant difference in diet between the sexes suggesting that all the studied individuals, except from one outlier, probably had a similar diet during childhood. This aspect becomes especially interesting when compared to microwear data and dental lesions of adult individuals from Loreto Ap.-Cappuccini, as a variation in diet is visible between the sexes. It can be inferred that, after a certain age, a distinction in diet between males and females started to appear. Such a distinction also seems to appear in the funerary practice after the childhood period and into the juvenile category, with grave goods indicating a gradual differentiation between the sexes with age.

An in-depth analysis on childhood and adult diet and how humans inhabiting this area of Abruzzo have used the land to produce food would be an important next step in the understanding of the studied pre-Roman population. Such an investigation would be particularly interesting if extended to individuals excavated from the Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries, where differences in dietary patterns between sexes were also observed.

8.3 Health among the Individuals from the Loreto Aprutino-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera Cemeteries

8.3.1 Stature and Body Mass as Biological Stress Indicators

Several types of stresses can affect the general health of individuals, with food deprivation and other kinds of disruption to conventional environmental circumstances playing a central role. There is a strong relationship between skeletal growth and stature (Larsen, 2002). Growth is assumed to be linear and is regulated by genetic, nutritional and environmental factors. Inequality in access to food resources, poor living and work conditions, and disease during skeletal development, can affect growth and the attainment of the full adult height (Goodman, 1991; Steckel, 1995; Larsen, 2002; Pinhasi, 2008; Mummert *et al.*, 2011). When considered all together, the stature estimation for the individuals of the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries was remarkably close to those of other populations excavated in Abruzzo Table 8.1. Moreover, the estimations were also in line with the ranges observed for the Iron Age/Roman period in Central-Southern Italy (Giannecchini and Moggi-Cecchi, 2008; Mancinelli and Vargiu, 2012; Sparacello *et al.*, 2017).

*Table 8.1 Difference in samples size (N), mean values (Mean), and standard deviation (SD) for stature of the studied cemeteries and other populations from Abruzzo. * = values published by Mancinelli and Vargiu (2012). F = Females; M = Males.*

Cemetery	**N**	**Mean (cm)**	**SD (cm)**
Loreto Ap.-Cappuccini (F)	5	152.5	1.6
Loreto Ap.-Cappuccini (M)	4	167.1	3.2
Moscufo-Via Petrarca (F)	3	155.4	1.4
Moscufo-Via Petrarca (M)	2	160.9	4.3
Spoltore-Quagliera (F)	2	155.7	0.5
Spoltore-Quagliera (M)	4	166.3	1.3
Campovalano (F) *	5	153.8	1.6
Campovalano (M) *	9	167.0	4.3
Fossa or-arc (F) *	7	155.2	5.8
Fossa or-arc (M) *	22	166.4	4.0
Fossa ell (F) *	19	154.6	3.3
Fossa ell (M) *	25	166.3	4.7

The sexual dimorphism in stature observed within the three cemeteries was marked, with males significantly taller than females. This was not surprising, as males tend to be taller than females, which could be genetically determined (Lettre, 2009). Females at the Loreto Ap.-Cappuccini cemetery were shorter than females from the Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries (152.5 ± 1.6 cm against 155.4 ± 1.4 cm and 155.4 ± 1.4 cm, respectively). The latter were also shorter than females from other sites in Abruzzo. This might suggest that, during childhood, the food consumed by female individuals from Loreto might have had a less positive impact on the attainment of the full hight. Further analysis can be done to better understand whether this factor (food) played a major role on the achievement of hight. If a better diet was linked to high social status, and the former was the cause of the attainment of full height, one should expect that individuals with richer burials were the tallest. The relationship between stature and social status has been widely investigated in past populations (Angel, 1975; Mummert *et al.,* 2011; Vercellotti *et al.,* 2011; Sparacello *et al.,* 2017; Holt *et al.,* 2018). Sparacello *et al.* (2017), studied the relationship between stature and status in a Samnite community from Alfedena (Orientalising-Archaic period), in Abruzzo. A relationship was observed between the changes in status and an increasing stature (Sparacello *et al*., 2017). This was valid for males but not for females, thus high-status males were taller than low-status males. This led to the hypothesis that taller high-status males had better access to resources such as animal-based food which led them to attain their final greater height. However, this pattern was not necessarily evident in the cemeteries under investigation in this thesis and, in some cases, the opposite was noted. One burial that exemplified this opposite trend was the T8, a female individual aged between 28 and 32 years, which showed the lowest stature among all females (150.0 cm) but the richest set of grave goods. Even when the isotope signals that provide insights into the diet during the growth period were considered, there was no clear distinction between this individual and others in the same cemetery. Therefore, it is likely that diet was not the main factor to affect the growth of this group of individuals, and other reasons were behind it. For example, genetics might have played a role, or the individuals had worse buffering from environmental stressors, which might have influenced the attainment of their optimal body height.

Along with stature, body mass can contribute to the understanding of how different types of stresses, such as nutritional and environmental stresses and genetic factors, affected individuals in the past. Scholars agree that climate and latitude have an impact on body mass variations (Ruff, 1994, 2002; Bogin and Rios, 2003; Niskanen *et al*., 2018). Body mass estimations of the populations from the three cemeteries were carried out. Statistically significant differences in body mass between females and males were observed when the cemeteries were pooled together, with the male body mass about 10 kg higher than the female body mass (Table 6.8). The values of females appeared to be more clustered within a less broad range compared to the values of males which, in contrast, presented a broader range of stature and body mass. Sexual dimorphism concerning body mass is not affected by climate, rather it is influenced by environmental and behavioural factors such as diet, sexual division of labour, and differential buffers against the environment (Ruff, 1987, 2002). When the single cemeteries were analysed, the individuals from Loreto Ap-Cappuccini showed greater sexual dimorphism, with 14 kg of difference. These results further emphasise that there was a more marked difference between the sexes at Loreto Ap.-Cappuccini compared to Moscufo-Via Petrarca and Spoltore-Quagliera, which was identified during the evaluation of theirs diet. This is certainly a point that will require more attention in the future.

Males and females from Moscufo-Via Petrarca, in contrast, presented a similar average body mass (females = 59.7 kg; males = 59.9 kg). Males from the Moscufo cemetery also exhibited the lowest stature compared to the other cemeteries. Low stature and low body mass could support the hypothesis that male individuals from Moscufo-Via Petrarca experienced higher levels of nutritional and/or environmental stress compared to the individuals from other cemeteries. When considering the data within an interregional context, the body mass means evaluated in the studied populations find similarities with French-Italian samples of the Iron Age/Roman period (Holt *et al.,* 2018). However, most of the individuals from Loreto Ap-Cappuccini (females BM mean = 58.1 Kg; males = 72 Kg), Moscufo-Via Petrarca (females BM mean = 59.7 Kg; males = 59.9 Kg), and Spoltore-Quagliera (females BM mean = 61.1 Kg; males = 68.1 Kg) presented higher body mass mean values than the French-Italian samples (Iron Age/Roman Age females = 54.5 Kg; males = 61.2 Kg). Only the males from the Moscufo cemetery were outliers and presented lower values than the others. Again, this suggests that individuals from Moscufo, and especially males, might have been subject to some type of stress that hindered the attainment of their full body mass.

8.3.2 Dental and Skeletal Markers of Stress

The evaluation of dental enamel hypoplasia (DEH) is considered as an indicator of growth disturbance and health. DEH revealed that the populations of Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries experienced high levels of stress during childhood. A high prevalence rate of DEH was observed in Loreto Ap.-Cappuccini and Moscufo-Via Petrarca, while this was less visible in Spoltore-

Quagliera. Spoltore might have had a population that was healthier during childhood, but one reason for the low DEH in Spoltore could also be the high enamel surface erosion, which in several cases hindered the visibility of the defect. Enamel defects appear during the stages of enamel maturation as a consequence of the disturbance of the normal activity of ameloblast deposition or during mineralisation. This can lead to the reduction of the enamel thickness or hypermineralisation (Soames and Southam, 2005). DEH can be caused by localised trauma, genetic, and systemic metabolic stress (Goodman and Rose, 1990). Ecological factors, dietary deficiency and social status are important as well; it has been documented that urban populations have less DEH defects than rural ones (Goodman and Armelagos, 1989; Larsen, 1997). In the Loreto Ap.-Cappuccini cemetery, DEH affected both male and female individuals with the same prevalence rate (100.0%). A similar trend was seen in Spoltore-Quagliera, though the prevalence rate for the two categories was lower (females = 48.9% and males = 50.0%). Differences between the sexes, from physiological and cultural perspectives, did not appear to have been involved in the formation of enamel defects. Most of the individuals from the three cemeteries presented discernible lines and, on rare occasions, gross defects were observed. Two examples of this are an adult male individual from Loreto Ap.-Cappuccini (T12) (Figure 8.1a) and a child aged between 5-6-years from Loreto Ap.-Cappuccini (T10) (Figure 8.1b) with a localised hypoplasia on the lower primary canine (LHPC). In the adult male individual (T12), aged between 30-35 years old, a diet which included an intake of proteins coming from meat or other foodstuffs during growth was suggested based on the nitrogen isotope signals. If diet had determined the DEH in this individual, it would be expected that the signals from the food would be indicative of limited nutrients; for this reason, obtaining the signals of meat was unexpected. It can be hypothesised that other factors may have been involved in producing physiological stress in this individual during the period of growth such as systemic diseases, poor life conditions, social and cultural stresses. In the 5–6-year-old child (T10), the defect is characterised by a roughly circular defective area of missing enamel on the buccal surface. LHPC is rarely reported in bioarchaeological research, and when present it is frequently found in literature associated to a high prevalence of caries (Duray, 1990; Halcrow and Tayles, 2008; Jančová *et al.*, 2019). In the 5-6-year-old individual, however, no dental caries were observed, and its formation may be associated to poor maternal health or to the experience of elevated stress conditions during the first years of life (McDonell and Oxenham, 2014).


a) b)

Figure 8.1 a) Dental enamel hypoplasia on a male individual (30-35-year-old), burial T12 Loreto Ap.-Cappuccini cemetery. b) Localised hypoplasia of the primary canine, 5-6 age at death, burial T10 Loreto Ap.-Cappuccini.

Low rates of skeletal pathologies were observed in the individuals from the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries. Immatures showed no sign of pathological lesions, which suggests that acute health problems may have caused their death without leaving any skeletal marks (Wood *et al.*, 1992; Goodman, 1993). Skeletal evidence of non-specific infectious disease was present across the three cemeteries, but their prevalence rates were low. Endocranial lesions were observed at Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera, but with very low prevalence rate. The aetiology of endocranial lesions is still debated, but it is often linked with trauma, inflammation of the meninges, and respiratory disease (Schultz, 1989; Hershkovitz *et al.*, 2002; Lewis, 2004). Lewis (2004) argued that these lesions in immatures are the results of inflammation of the meninges, and can be caused by bacterial infection, vitamin deficiency, pneumonia, gastroenteritis, or tuberculosis. Only three juvenile individuals across the cemeteries exhibited the lesions, that is those in burial T32 at Loreto Ap.-Cappuccini, T21 at Moscufo-Via Petrarca and T6 at Spoltore-Quagliera. Since the appearance of new bone in the endocranium is the result of a chronic condition, it may be possible that those with lesions survived long enough for the inflammation to become chronic. These individuals did not present any apparent skeletal pathology to indicate the possible cause of endocranial inflammation. In addition, to date, there is limited research that has been published about the expression of these lesions among ancient Italian populations, which complicates any comparison with the populations currently under study.

In addition to endocranial lesions, few observations of sinus inflammation were noted at Loreto Ap.-Cappuccini and Spoltore-Quagliera. A total of four male individuals over thirty-seven, two at Loreto (T11 and T14) and two at Spoltore (T10 and T22), presented sinusitis. Sinusitis is an inflammation of the sinus mucous membrane and when the inflammation persists new bone may form in the sinus. Bacterial organism and fungi are involved in chronic sinusitis (Roberts, 2007; Waldron, 2009). The cause of the inflammation can be poor ventilation, air pollution, respiratory tract infection and dental disease (Mehra and Jeong, 2009). The two individuals from Loreto Ap.-Cappuccini with sinus inflammation also exhibited a high degree of carious lesions, antemortem tooth loss, high degree of wear, and periapical abscesses. The old adult male buried in T14 also showed sign of erosive lesions on the petrous part, a thickening of the cranial vault, abnormal new bone formation on the articular joints, and formation of bone tissue on the left petrous part. Similarly, the two individuals from Spoltore-Quagliera presented poor dental health and signs of erosive lesions on the left petrous part. In both cases poor dental health and non-specific infection may have led to the inflammatory reaction of the maxilla sinuses.

Six individuals out of the 22 analysed at the Loreto Ap.-Cappuccini and Spoltore-Quagliera cemeteries exhibited cribra orbitalia. In both cases, the highest prevalence was observed among juveniles. Cribra orbitalia is identified as porosity and pitting on the orbital roof and is most commonly attributed to acquired or genetic forms of anaemia (Aufderheide and Rodríguez-Martín, 1998; Ortner, 2003). Iron-deficiency anaemia is one of the most frequently occurring forms, however new research has shown that megaloblastic anaemia is more likely to cause cribra orbitalia (Facchini *et al.*, 2004; Cucina *et al.*, 2006; Walker *et al.*, 2009). Infants develop megaloblastic anaemia when they ingest maternal milk depleted of B_{12} and are exposed to unsanitary conditions. Both these conditions result in vitamin deficiency and possible development of cribra orbitalia

(Cucina *et al.,* 2006; Walker *et al.,* 2009). Research at the Pontecagnano cemetery in Central Italy (7th–3rd centuries BC) showed that cribra orbitalia was not linked to nutrition deficiency, but rather to a congenital origin such as thalassemia (Fornaciari *et al.,* 1989). In fact, palaeodiet analysis showed that the individuals buried in this cemetery had a diet rich in proteins (Fornaciari *et al.,* 1989). Therefore, there is a real possibility that the presence of cribra orbitalia at Loreto and Spoltore may also be due to malaria. Evidence of malaria in Central Italy during the 4th-1st centuries BC is documented by Latin sources (e.g., Pliny the Younger, *Naturalis Historia*, V.6.2.) and direct observations of skeletal material (Sallares *et al.,* 2004; Marciniak *et al.,* 2018). Additional analyses will be necessary to determine whether or not malaria was the cause of cribra orbitalia among the populations of the Loreto Ap.-Cappuccini and Spoltore-Quagliera cemeteries. Due to the absence of other indicators, nutrition, iron deficiency, hygienic problems and other causes of infection may be the most likely explanations for cribra orbitalia (Sonego and Scarsini, 1994; Paine *et al.,* 2009). In Moscufo-Via Petrarca, there were no individuals with either sinusitis or cribra orbitalia, hence either the population had good health or individuals were dying rapidly and there was no time for the lesions to appear. It is also possible that the small sample size and the poor/moderate bone surface preservation prevented any observation and recording of the infectious disease.

8.3.3 Skeletal Indicators of Health Related to Age and Mechanical Stress

The populations of the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera cemeteries exhibited a low prevalence of appendicular degenerative joints diseases (ADJD). As expected, juveniles did not present osteoarthritis at any of the sites, which might have indicated that the individuals consistently conducted physical activities, i.e., heavy labour, at an early age. ADJD started to become visible in the young adults, and the Loreto Ap.-Cappuccini cemetery was the one that showed the highest prevalence until old age. Wrist/hand and ankle/foot were the more affected joint complexes (Table 6.34). There is no clear difference between female and male individuals.

Osteoarthritis of the spine was highly prevalent across the cemeteries, with higher prevalence in Loreto Ap.-Cappuccini. Spinal osteoarthritis refers to the degeneration of the cartilaginous structure of the synchondroses joints of the spine (Waldron, 2009). The aetiology of osteoarthritis is not fully understood, however it has been suggested that multiple factors such as age, sex, obesity, genetic, and mechanical stresses play a major role in determining osteoarthritis in the spine (Jurmain, 1977; Ortner, 2003; Waldron, 2009; Gellhorn *et al.*, 2013). Clinical and archaeological research has shown that lumbar vertebrae are usually the most affected (Sofaer Derevenski, 2000; Kramer, 2006). This is in line with the results found at Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera, where the highest prevalence of osteoarthritis was found in the lumbar area. Cervical vertebrae were highly affected as well.

When broken down into sex, males appeared to be slightly more affected than females, however there was not a statistically significant difference (Figure 6.35). This pattern finds similarities with other contemporary populations of Central Italy (Schultz, 1989; Rubini and Coppa, 1991; Petrone, 1994; Sonego and Scarsini, 1994). The high prevalence of spinal osteoarthritis in the cemeteries of Gildone and Guglionesi (Molise, 6th-4th centuries BC) was attributed to stresses due to load-bearing and intensive work activities, probably as a consequence of agricultural activities or activities that require repetitive motions and heavy lifting such as construction. (Petrone, 1994; Sofaer Derevenski, 2000; Zhang et al., 2017). Indeed, this was emphasised by the high prevalence of Schmorl's nodes among male individuals (Petrone, 1994). In the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera cemeteries, Schmorl's nodes primarily affected female individuals and the thoracic area of the spine. Schmorl's nodes are the herniation of the nucleus pulpous through the annulus fibrous into the endplate of the adjacent vertebra (Schmorl and Junghanns, 1971; Urban and Roberts, 2003). These herniations are commonly interpreted as the direct result of trauma to the vertebra, mechanical stress and workload, or developmental disease. However, the pathogenesis of Schmorl's nodes is still debated (Jurmain, 2003; Weiss, 2005; Plomp *et al.*, 2015). Osteoarthritis and Schmorl's nodes are commonly found among the elderly as skeletal marker of degeneration. In the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera cemeteries both osteophytes and nodes were observed among juveniles as well. This may suggest that juveniles were already experiencing some sort of mechanical or physiological stress. At Pontecagnano (Salerno, 7th-3rd centuries BC) a correlation was found between the presence of males with Schmorl's nodes and the number of grave goods in individuals' burials (Robb *et al.*, 2001). It was suggested that the few grave goods in male burials were indicative of a low social status concluding that those individuals were subject to heavy labour, and that might have resulted in the herniation and the formation of the nodes (Robb *et al.*, 2001). In the three studied cemeteries, the relationship between Schmorl's nodes and grave goods/social status is not clearly visible, as all the individuals with Schmorl's nodes were buried with grave goods indicating wealthy individuals.

Considering the observations made in previous sections regarding the diet of the individuals buried at these sites, which suggested that these groups might have consisted of farmers, indicators of physical activity connected to agriculture were expected. As a result, it was anticipated that several individuals would present osteoarthritis in the shoulder joint complex. These expectations were partially met, whereby osteoarthritis of the spine, in particular in the lumbar and cervical region, was observed. However, osteoarthritis indicators typical of agriculturists were not detected.

8.3.3.1 Evidence of Trauma

There is little evidence of traumatic lesions across the populations of the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera cemeteries. Only three individuals from Loreto Ap.-Cappuccini exhibited cranial trauma. A 45-50-year-old female (T40.1) showed a probably penetrating trauma on the superior surface of the skull of the right parietal and there are no signs of bone reaction. A similar penetrating trauma was observed on the right parietal of a 20-25-year-old male individual (T28). The traumatic lesion consists of a small aperture of irregular margins with signs of bone reaction and new bone formation on the endocranial surface, and probable initial healing. The third case is a 40-50-year-old male (T11) with a depressed trauma on his left parietal and an inflammation reaction on the ectocranial surface. The little evidence of traumatic lesions differs from the evidence from Alfedena (6th-5th centuries BC), where the data of cranial trauma were considerably high. The traumatic cranial injuries found at Alfedena were thought to be the result of interpersonal violence between the Samnite community and rival communities (Paine *et al.*, 2007). It was suggested that this pastoralagricultural community was probably engaging in small conflicts over the protection or acquisition of the resources (Paine *et al.*, 2007). Similar considerations were made for the traumatic cranial trauma found at Pozzilli (Molise, 6th-4th centuries BC) (Brasili *et al.*, 2004). It has been suggested that the lesions were the result of aggression and interpersonal violence rather than an accident, as males were more affected than females (Brasili *et al.*, 2004). In addition, the population at Pozzilli suffered from postcranial traumatic lesions mainly of the clavicle and radius. Based on the nature of the cranial trauma, postcranial fractures, and on the presence of iron spears, knives or blades, it was suggested that the population of Pozzilli may have had a violent lifestyle (Brasili *et al.*, 2004). The total absence of traumatic lesions in the individuals buried at Moscufo-Via Petrarca and Spoltore-Quagliera appears to confirm that those groups were not likely to be involved in conflicts. Instead, the majority of the injuries present in the three studied cemeteries were clavicular fractures, which are more consistent with falls. Similarly, a more consistent pattern of traumatic lesions should have emerged from the analysis of individuals buried at Loreto Ap.-Cappuccini if they had been involved in major violent events. It is therefore difficult to conclude whether or not the cranial lesions seen at Loreto Ap.-Cappuccini were the result of minor conflicts, and differential preservation might have limited the ability to see traumatic lesions on other skeletons.

If the analysis of the grave goods is associated with observations related to trauma, the males exhibiting the lesions were buried with a spearhead (T11) and a long sword (T11 and T28). In T11 a dark brown substance was present which led the archaeologists to make the hypothesis that, at the time of inhumation, a shield made of an organic material was buried with the individual (Staffa, 2003a). These objects may indicate that the two male individuals were engaging in activities that required weapons, as was suggested for individuals at Pozzilli (Brasili *et al.*, 2004). Although this is a possibility, these grave goods could have been part of the funerary ritual and might have had a merely symbolic function.

8.4 The Expression of Gender and Identity during Individuals Life Course

The themes discussed in this section are pivotal to better comprehend how the populations considered in detail in this study expressed their identity and gender in different stages of their lives. It is of course important to underline that the expression of individual identity in burials is not straightforward. The funerary rituals reflect the burying process of the living and the items accompanying the deceased may not necessarily represent personal possessions, as they may also embed social or ideological meanings (Parker Pearson, 1999). At the same time, the expression of gender should be thoroughly investigated and the relationship between biological sex and gendered objects needs to be questioned and not assumed *a priori*. The concept of gender in past societies can be very articulated and intricate, and consequently, fluidity in gender expression should be considered. There have been exceptional occasions where both spindle-whorls and razors, thought to represent respectively the female and the male gender, were found together as part of the burial goods of one individual (Bietti Sestieri, 1992; Toms, 1998; Walton Rogers, 2007). Moreover, it has also been suggested that other items such as ceramic and metal vessels might be indicative of how gender and social roles were defined in ancient Italian societies (Scopacasa, 2014b).

At Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera the relationship between biological sex and gendered items was evident for most of the burials, although there were occasions in which gender was difficult to interpret, either because of the lack of objects in the burial or because of the absence of gendered objects. These may be explained by the fact that not all of the population had the economic resources to express gender in burials, or that perishable materials were used as gender indicators (Toms, 1998). To support the interpretation of gender and identity amongst the three sites considered in detail in this study, the cemeteries at Pescara-Ex Gesuiti and Nocciano (6th-4th centuries BC) were included in the observation. It must be acknowledged that skeletal remains are not present at either of these sites, and as such precise conclusions cannot be made on the expression of gender in relation to the biological sex of those individuals. However, based on the evidence from the other cemeteries studied, we could carefully assume that gendered objects were the reflection of the biological sex of the individuals buried at Pescara-Ex Gesuiti and Nocciano.

8.4.1 Gendered Embodiment: The Process of Inhumation

The process of burial adopted by these populations finds parallels with other Italian pre-Roman populations, a few examples are represented by the cemeteries at Satricum in the Lazio region (Gnade, 1992) or at Bazzano (Weidig, 2014) and at Opi Val Fondillo (Faustoferri, 2003) in Abruzzo. The archaeological evidence for the cemeteries considered in this study suggests that the burial practice changes as the age of the individual increases, however there was no explicit correspondence between funerary rituals and biological conditions of individuals. Infants were buried in simple *fossa*e with a set of ceramic vessels of small size and ornamental accessories. The more articulated burial practice, distinctive of adult individuals, was attested in two burials of children. It consisted of an *olla* placed half way up the burial wall and a diversified paraphernalia that was defining the gender and status of the individuals. This was visible in two individuals for the cemeteries at Loreto Ap.-Cappuccini and Spoltore-Quagliera, but not at Moscufo-Via Petrarca as there were no skeletal remains of children.

An immature individual aged 5-6-year-old from the Loreto Ap-Cappuccini cemetery (T10) was inhumed with the *olla* placed half way up the wall of the burial pit, resembling adult inhumations, and several fibulae and a set of ceramic vessels, among which an amphora. This may suggest that rank and status were acquired through hereditary transmission, if the *ollae* were considered indicative of the wealth of family groups. Of particular interest was the immature individual aged 8-11-year-old from Spoltore-Quagliera (T2), who had the *olla* position in the same place as the individual at Loreto, however this burial appeared more articulated than the previous one. The 8-11-year-old child was buried, among other items, with a spearhead, a knife and an iron spit, resembling adult male inhumations. There is ongoing discussion about the meaning these objects have in burials. It has been suggested that the presence of combat-related objects in burials is not always related to the sex of the deceased, but they are more likely to symbolically reflect the individual’s role and status in society gained through military success or through control of resources (Rubini *et al.*, 2002; Bispham, 2007; Scopacasa, 2015). The presence of combat-related objects buried with this young individual may be interpreted, therefore, as a symbol of transition from childhood to adulthood of a probably high-status individual, and the spearhead, knife/dagger, spit, and razor could have had a symbolic value (Bispham, 2007). What was observed in these two examples was that the *olla* may be imbued with symbolic and ritual values. The *ollae* were suitable for mixing and serving drinks, probably wine, as well as storing foodstuffs (Di Niro, 1991; Staffa, 2003a). Nearly half of the adult population at Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera were buried with this vessel, while at Pescara-Ex Gesuiti and Nocciano almost all the burials contained it (Staffa, 2001, 2003a, 2010; Staffa and Cherstich, 2009, 2020). At Loreto and at Moscufo the *olla* was not selective of a specific sex, both female and male individuals had it in the burial. A different consideration should be made for the Spoltore-Quagliera cemetery, where the *olla* was replaced by larger *olla/dolium* which was selective of male burials, becoming therefore a gendered object embedding different values.

Gender and identity were exhibited in juvenile and adult male burials by the presence of combat-related objects, spits, and razors. Swords and spearheads were the most frequent objects found in biologically sexed males at Loreto Ap.-Cappuccini and Moscufo-Via Petrarca, while at the Spoltore-Quagliera knives/daggers were more prevalent (72.8%). A scarce representation of these objects was seen at the Pescara-Ex Gesuiti, and Nocciano cemeteries (Table 7.11). The expression of gender and identity of biologically sexed female individuals at Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera was mainly represented by the presence of objects used for dress and bodily adornment, as well as textile related tools. Objects utilised for spinning and weaving were often associated with the role and status of women in society (Gleba, 2008). Spindle-whorls, spindles, needles, and reels were the items indicative of the role and gender of selected individuals from Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, Spoltore-Quagliera, Pescara-Ex Gesuiti, and Nocciano. Spindle-whorls were the most frequent objects found and, at Loreto Ap.-Cappuccini in particular, more than half of the females were buried with them. It is important to highlight that these items did not appear to be restricted to a specific age category, rather they appeared in burials of elderly and middle-aged females, as well as of juveniles (Loreto Ap.-Cappuccini T15

PEEP2; Moscufo-Via Petrarca T16). This may suggest that knowledge was transferred from the elderly to the young, and that gender roles were acquired through the life-course and modified on the basis of the social and cultural values defined by the community. Gleba (2008) and Bonfante (2003) stressed that the meaning that these items hold in the burial context goes beyond gender. Status, wealth and family origin were emphasised, as well as the skill and the level of specialisation that these activities required. Of interest is the inhumation of a female individual (age at death 28-32 years) from Loreto Ap.-Cappuccini (T8). The presence of chipping on her maxillary incisors could represent the evidence of teeth used for work-related activities, although the chipping may also be caused by the combination of both masticatory and non-masticatory activities, thus the data should be interpreted cautiously. Spindle-whorls and animal bones (sheep bone) found in the burial of this individual, in addition to dental chipping, led to assumptions that this person was somehow involved in activities related to textile working. This link between the presence of textile tools and the dental chipping was observed in other cases across the three studied cemeteries, supporting the evidence that selected women were inclined to textile-related activities, or that the textile tools were positioned in the burial as a symbol of wealth. The textile materials found at Verucchio (7th century BC), in addition to the depictions of two women weaving and working on each side of the loom (from the throne of Verucchio tomb 89), strengthen the concept of the importance that the role of weaving had in reflecting the personal identity (Bonfante, 2003; Knudsen, 2012). It may be possible that textiles and textile-making held a similar significance for the gendered roles, status, and kinship of the women in the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, Spoltore-Quagliera, Pescara-Ex Gesuiti, and Nocciano cemeteries.

8.4.2 Gendered Embodiment: Adorning the Body

Burial data returned informative evidence on jewellery and dress accessories worn by female individuals in the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, Spoltore-Quagliera, Pescara-Ex Gesuiti, and Nocciano cemeteries. Textiles are not usually preserved in burials, though dress accessories such as fibulae or other ornaments may shed light on how the apparel was attached to the body and which materials were selected to adorn clothing (Carroll, 2013; Harlow and Nosch, 2014; De Cristofaro and Piergrossi, 2017). Jewellery provide additional information about the wearer and his or her ethnicity and cultural identity (Carroll, 2013). Differences in apparel and dress accessories were evident in adult female and male individuals. The dress accessories of males were restricted mainly to iron fibulae, nevertheless, a breast plate (*kardiophylax*) was found among the grave goods of a 18-20-year-old individual at Spoltore-Quagliera. The fibulae might have had the function to fasten a cloak on clothing worn beneath it, as may be indicated in the burial of an old male from Loreto Ap.-Cappuccini (T14), where two fibulae were present on the left clavicle of the deceased. Alternatively, they might have been used to connect two ends of tunic, as in burial T20 where a fibula was found over the pelvis of the deceased, on the left side of the vertebral column. Even though it is thought that daggers and scabbards were attached to a belt by mean of a small chain with a large ring (Weidig, 2014), and they are present across the investigated cemeteries, there was no archaeological evidence for the use of belts among males except at Spoltore. One of the reasons is that belts were probably made of organic materials, such as leather, which degrades over time in normal deposition conditions (D'Ercole, 2014b; Papi, 2014; Weidig, 2014). At Spoltore-Quagliera a bronze belt was part of the grave goods of a 17-18-year-old male (T30). In addition to the belt, the deceased had several rings and clasps on his sternum and iron fibulae near his shoulders. Staffa and Cherstich, (2020) suggested that the presence of this item is indicative of the link between this individual and southern Italian cultures. The authors hypothesised that the deceased might have worn a special dress or textile armour, as fibulae and other ornaments were rarely found in male burials. Bronze belts (or 'Samnite' belts), frequently found in Central-South Italy, are commonly associated with the image of the warrior, and considered as part of the military equipment possessed by men (D'Ercole, 2020). This interpretation was questioned by Herring (2018) who argued that the bronze belts held an important symbolic value and were considered a significant social item in the male sphere. Herring (2018) also argued that the direct relationship between bronze belt and warrior is not always supported by the biological conditions of the individual buried with this object. The juvenile individual buried at Spoltore (T30), indeed, did not show any apparent traumatic lesions linked to combat.

The funerary dress of adult and juvenile females was more elaborated compared to the male ones. It consisted of one or more iron and bronze fibulae often placed on the shoulders, as depicted on the torso of the so-called lady of Capestrano (Franchi Dell'Orto, 2010). The fibulae were often accompanied by pendants, such as tweezers, bronze rings, and bone or limestone discs. A 24-28-year-old female from Spoltore-Quagliera (T25) was buried with two large iron fibulae placed on both shoulders, accompanied by rings, small chains and ivory disc pendants, as well as glass beads and two Phoenician glass face beads. At Loreto Ap.-Cappuccini females were adorned with similar paraphernalia, however they lacked the ornaments made of coral and ivory present at Spoltore-Quagliera. Necklaces made of glass paste, bronze, amber, and stone beads were found in at least one female burial within each cemetery. Loose glass paste beads were commonly present, probably used to decorate the textile (Gleba, 2017). Not all the individuals in the studied cemeteries were buried with this set of dress ornaments and adornment, possibly suggesting that these might have been ceremonial dresses used by the aristocratic women of the community (Papi, 2014; De Cristofaro and Piergrossi, 2017). Most of the finds have parallels with contemporary neighbouring cemeteries like Montebello and Penne, as well as with other cemeteries within the region (Martellone, 2010).

A typical item characterising the female dress of the upper and lower area of Pescara is a line of bronze rings. These rings, which are not interlinked like a chain, were found at Loreto Ap.-Cappuccini (T8, T15, T32), Moscufo-Via Petrarca (T17, T20, T21), Spoltore-Quagliera (T25), Pescara-Ex Gesuiti (T6) and Nocciano (T8). Where skeletal remains had survived, it was possible to link the ornament with juvenile and adult female individuals. It was suggested that these rings were orderly aligned and sown on a fabric which might have been used as veil to cover the hair (Staffa, 2010; Staffa and Cherstich, 2020). The fabric did not survive, however studies on fibres and textiles used during the Pre-Roman period in Central-South Italy leads to the conclusion that either wool or linen were the textile in question (Shelton, 2009; Gleba, 2017). The position of the rings was not always the same in all the burials: occasionally they were found lying over the body of the deceased, or placed on the lateral side of the body, or over the head. Similar evidence of the use of this ornament comes from South Italy (burials number 314 e 631 from Chiaromonte-Sotto la Croce, Potenza), where the rings were found on the body as they were sown on a textile resembling an apron. In contrast, at Numana and at Osteria dell'Osa they were interpreted as rings sewn on a shroud used to wrap the body (Bietti Sestieri, 1992; Delpino *et al., 2016)*. Based on the dimension and position of the rings in the burials, it is more likely that those rings found at Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, Spoltore-Quagliera, Pescara-Ex Gesuiti, and Nocciano were more compatible with dress ornament than a shroud (Figure 8.2). Furthermore, this dress ornament appears to be characteristic of the upper and lower Pescara region, as there is no evidence of their use in the cemeteries in the mountainous area of Abruzzo (e.g., Fossa and Bazzano).

Figure 8.2 Position of bronze rings over the head of an adult individual. Burial n. 2, San Clemente a Casauria, Pescara. Museo delle Genti d'Abruzzo, Pescara. Photo by the author.

Covering the hair with a veil adorned with fibulae, a diadem or metal ornaments might have been a practice that characterised the female sphere for a long period of time. It has been suggested that ornaments and jewellery worn by females were considered a marker of wealth and status (De Cristofaro and Piergrossi, 2017). This habit may explain the presence of the rings positioned on the head of the deceased in the San Clemente a Casauria, Pescara cemeteries, as well as in the other studied sites.

Dress accessories and jewellery with infants and children resemble those found in the juvenile and adult female groups, although they vary in quantity and variety. Bronze and iron fibulae were frequent in immature burials, suggesting that they were probably draped in cloth or wrapped in a shroud during the deposition in the grave. Torques and necklaces made of glass paste, amber, bone beads, as well as isolated glass paste beads and bronze disk pendants were worn by children. Beads and pendants are often considered amulets given to babies and children as protection. However, it is thought that these objects also had social values and represent an identity marker (Costanzo and Dubois, 2015; Carroll, 2018). In the studied cemeteries the number of dress accessories and items of jewellery varies within the immature graves, although it was difficult to evaluate if this variation was the result of age differences or status. In fact, the age at death was determined on only six skeletons, due to the absence of skeletal remains.

8.5 Mobility in the Loreto Aprutino-Cappuccini Cemetery through Stable Isotope Analysis

The strontium isotope analyses used to study mobility in the population at Loreto Ap.-Cappuccini unveiled preliminary data worth of consideration in the light of understanding dynamics of integrations among individuals. The strontium isotope values from the enamel samples of 16 individuals from the Loreto Ap.-Cappuccini cemetery was consistent with the strontium signatures of the Abruzzo region, suggesting that these individuals were local of the area. The $^{87}Sr/^{86}Sr$ values indicated the presence of three groups of people buried at Loreto Ap.-Cappuccini, two of them stands out for their clearly different signatures. The first group of four individuals (T8, T32, T31, T15) with $^{87}Sr/^{86}Sr$ range = 0.079295-0.709899, appeared to have been born and raised in the hilly area between Loreto Aprutino and Pescara (Figure 6.50). The second group consisted of ten individuals (T7, T5CORO, T4CORO, T43.1, T40.1, T39.2, T22, T21, T12, T11) with lower $^{87}Sr/^{86}Sr$ values ($^{87}Sr/^{86}Sr$ range = 0.0708105-0.709098). These are compatible with the $^{87}Sr/^{86}Sr$ values from the groundwater of Meso-Cenozoic units, of which the Gran Sasso massif is formed ($^{87}Sr/^{86}Sr$ range = 0.7076 - 0.7092). In addition, those low $^{87}Sr/^{86}Sr$ values were in line with the strontium signatures found in two Upper Palaeolithic animal samples from Grotta di Pozzo (near lake Fucino, west Gran Sasso massif, Abruzzo) (Pellegrini *et al.*, 2008). Based on the $^{87}Sr/^{86}Sr$ values characterising the area of the Gran Sasso, it is possible to suggest that the second group might have migrated from the mountain area to the eastern area of the Gran Sasso. Another explanation may be that these ten individuals were local but ate food not cultivated locally or drank water coming from a different geological formation.

The hypothesis that this group of people migrated after childhood, opens the dialogue on the process of social integration (Killgrove and Montgomery, 2016; Cavazzuti *et al.*, 2019b, 2019a). Based on the information gathered so far on diet, health, and funerary practices, for the individuals buried at Loreto Ap.-Cappuccini, a few conclusions can be drawn. The absence of visible differences in the funerary practice at Loreto Ap.-Cappuccini, and the inclusion of the nonlocal group within the communal cemetery, suggest that the immigrants were somehow integrated within the society. An additional interesting aspect that emerged from the integration of the strontium analysis with other data obtained from the analysis of these individuals, is related to diet. Stable isotope analysis showed that the immigrants to Loreto Ap.-Cappuccini and the locals had a similar diet during childhood. This outcome is of interest because it brings to consider that the food intake of children in the mountainous and in the hilly areas of Abruzzo was, unexpectedly, not different.

These interpretations must be considered as a preliminary attempt to study short-distant mobility among the population buried in the Loreto Ap.-Cappuccini cemetery. This study has shown that it is possible to identify potentially non-local individuals, however it is necessary to increase environmental information in order to strengthen these results. The limited $^{87}Sr/^{86}Sr$ biosphere data available for the region under investigation and the absence of oxygen isotope ratios, which give information on the climate and elevation, and thus vary from east to west, do not allow us to draw definite conclusions regarding the mobility of these people.

Chapter 9 Conclusion and Outlook

The present study aimed to characterise the biological and socio-cultural variability among the populations inhabiting the hinterland and lower Pescara valley in Abruzzo, to determine whether there were differences in diet, health, and identity across different groups. This is the first study ever conducted on the skeletal human remains retrieved in the Abruzzo area, becoming the first biocultural study, integrating biological and cultural data.

The results obtained from the analyses of the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera cemeteries have helped to shed light on this little-known area of Abruzzo. Based on the archaeological evidence known to date, and on the results of the present work, the populations inhabiting this land were small rural communities. The demographic profile of the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera cemeteries appears to be similar. Infants were under-represented, with one of the most plausible explanation for this being the differential treatment of inhumations reserved to infants and children, such as preferential burials in settlements or in areas of the cemeteries not yet excavated. As far as the distribution of the burials at Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera cemeteries is concerned, no apparent recognisable pattern is clearly visible. This is an interesting aspect to consider in light of the strontium isotope results from 16 individuals at Loreto Ap.-Cappuccini, where potential immigrants were identified. The absence of visible differences in the funerary practice at Loreto Ap.-Cappuccini, and the inclusion of the nonlocal group within the communal cemetery, suggests that immigrants were somehow integrated within the society.

This research has shown that the relationship between health, diet and social status is complex and multifaceted, and not clearly recognisable in the analysed cemeteries. By combining macroscopic observation of dental pathologies, dental microwear texture analysis and isotope analysis, it was possible to observe that diet differed across cemeteries, between sexes, and it changed with across age categories. The two cemeteries that showed significant differences in diet were Loreto Ap.-Cappuccini, located in the hinterland area of Abruzzo, and Spoltore-Quagliera, located on the Adriatic coast. The individuals at Loreto Ap.-Cappuccini had a diet that resemble the one of farmers, with varied and soft food. The individuals at Spoltore-Quagliera, instead, showed microwear values in line with those of foragers who eat hard foods. Microwear values at Spoltore-Quagliera may also be explained as a consequence of ecogeological factors, being near the sea, or different food preparation techniques. The discrepancy between the two cemeteries was also confirmed by the different patterns of dental lesions. In addition, dental microwear analysis highlighted that female and male individuals of Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera were eating different foodstuff, with females favouring softer and more varied food compared to males. At Loreto Ap.-Cappuccini, dental microwear texture analysis carried out on immatures, revealed that diet changed as age increased. Immatures ate tougher and more fibrous food than adults. The diet of the Loreto Ap.-Cappuccini population was further analysed using carbon (^{13}C) and nitrogen (^{15}N) isotope analyses. Female and male immatures had a predominantly terrestrial C_3 diet, with a small contribution of C_4 plant, such as millet. In addition, the low $\delta^{15}N$ values suggests that legumes and/or vegetables were primarily consumed, whilst marine proteins were not part of their diet.

The absence of metabolic diseases and the low prevalence of endocranial lesions, sinusitis, and cribra orbitalia, suggest that these individuals were generally healthy. Although, it should be noted that the high prevalence of moderate hypoplastic defects observed at Loreto Ap.-Cappuccini indicate that these individuals experienced a high level of nutritional or physiological stress during childhood. It could be possible that the diet was not nutritious enough for the immature individuals. Overall, the individuals at Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera showed very low traumatic lesions and were inclined to activities that did not highly impact the appendicular skeleton. In contrast, the individuals at Loreto Ap.-Cappuccini, Moscufo-Via Petrarca showed osteoarthritis in the spine, specifically on the cervical vertebrae. This may be the result of carrying baskets over the head, overloading the neck, or doing activities that requires bending the back, such as harvesting, grinding cereals, leather tanning or wool processing as supported by the high prevalence of Schmorl's nodes.

Age plays an important role in the construction of identity among these populations. It is likely that the acquisition of a social identity came with age, as inferred by the observations at Loreto Ap.-Cappuccini and Moscufo-Via Petrarca, where textile tools appeared in burials of elderly and middle-aged females, and in one burial of a juvenile female. This suggests that knowledge was transferred from the elderly to the young, and that identity was acquired through the life-course and modified on the basis of the social and cultural values defined by the community. A similar hypothesis can be made for children and juvenile males, who, on several occasions, were buried with combat-related objects, spits, and razors.

To conclude, this thesis showed that inter- and intra-populations variability were visible specifically in relation to diet. The relationship between diet and social status resulted rather unclear and needs to be further investigated, whilst it was observed that diet changed across categories of age and between sexes. Age plays an important role in the construction of individuals' identity. In these populations is likely that the acquisition of a social identity came with age, as seen in other contemporary populations. This research used multiple techniques to investigate health, diet, and identity of the individuals from this part of Abruzzo, providing an insight into several aspects of the social life of these communities. As the first biocultural study of these populations, the thesis will constitute an essential platform for additional research that will follow in the future.

9.1 Limitations

The small sample size, the moderate or poor preservation of the skeletal remains, and unsystematic archaeological recovery constitute the three main factors limiting a better understanding of skeletal pathology. Widening the sample size would enable a more in-depth demographic analysis, for example by establishing a population mortality profile. At present, however, the only available collections are those that were object of this study, hence it is necessary to wait for future fieldwork to increase the sample. Preservation also can influence the visibility of a pathological condition; the high fragmentation of the vertebrae, for example, probably is the reason for the scarcity of spinal osteoarthritis detected in the bones excavated at Spoltore-Quagliera. Similarly, the relatively high level of corrosion of tooth enamel might have obscured the presence of dental linear hypoplasia. The unsystematic recovery and the post excavation commingling of the Moscufo-Via Petrarca samples only allowed a partial analysis of the skeletons. Therefore, the differences found in dental and skeletal pathologies among the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca and Spoltore-Quagliera could be the result of different skeletal preservation. It is possible that this may have led to an under- or overestimation of some pathological conditions.

The inaccessibility of some excavation reports, due to Italian bureaucracy, for examples, represents another issue that hindered the complete reconstruction of the funerary contexts. Published resources constituted the only source of information, as access to excavation reports was restricted. Detailed descriptions made the study of the Loreto Ap.-Cappuccini, Pescara-Ex Gesuiti and Nocciano cemeteries possible, whilst it was more problematic for the Moscufo-Via Petrarca and Spoltore-Quagliera cemeteries which have only recently been excavated and are undergoing study by the excavators.

As for stable isotope analyses, both for carbon and nitrogen, and for strontium, the main limiting factor was the relative lack of a bioarchaeological signature of the area; strong comparative data for the interpretation of the results was lacking. As a consequence, the interpretation of the results included in this thesis should be considered as preliminary and will need to be expanded in the light of available data in future.

9.2 Outlook

This study provided an insight into the diet, health and identity of the populations of the Lower Pescara valley and its hinterland. This opens research into one of the pre-Roman populations who lived in a transformative and developmental period of Italic cultural and political transformation, and it can be used as a first step for a greater understanding of the life of small Italic communities in the 6th-4th century BC. As already noted, this study was the first ever done on the skeletal remains of the Loreto Ap.-Cappuccini, Moscufo-Via Petrarca, and Spoltore-Quagliera cemeteries. Therefore, an in-depth re-examination of the skeletons may reveal new information on dental and skeletal health. For example, studies focused on specific pathologies of the skeletal collection could provide new information that allow us to compare the studied populations to other neighbouring populations in Italy.

A detailed analysis of carbon and nitrogen isotopes of the individuals of Spoltore-Quagliera would be useful to provide a greater understanding of the differences in diet between the groups living at Loreto Ap.-Cappuccini and Spoltore-Quagliera observed in the microwear texture analysis.

Oxygen isotope analysis, coupled with the strontium data obtained for the Loreto Ap.-Cappuccini sample, could strengthen the results included in this thesis. Strontium analysis on the population from Loreto-Ap.-Cappuccini, for example, identified potential evidence of migration, and oxygen isotope analysis might further support this hypothesis. In addition, it would be interesting to compare the isotope values of the Loreto Ap.-Cappuccini population with that of neighbouring pre-Roman populations, to understand patterns of local mobility in Central-South Italy.

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Appendix A– Skeletal Data

This Appendix contains the data concerning the skeletal information for the three cemeteries included in this thesis. The data are reported in the following order:

- Loreto Aprutino-Cappuccini;
- Moscufo-Via Petrarca;
- Spoltore-Quagliera;

The tables reported below include information regarding the single burials. The burial number is showed on the same row of the age, sex, stature, body mass, bone surface preservation, skeletal completeness and dental completeness of the individual as determined during the data collection.

Loreto Aprutino-Cappuccini cemetery

Individual	Age ranges	Sex	Stature (cm)	Body mass (kg)	Bone surface preservation	Skeletal completeness	Dental completeness
T04 PEEP2 LA	Unknown	Unsexed	_	_	Destroyed	0-25%	No teeth present (Postmortem loss)
T05 PEEP2 LA	Unknown	Unsexed	_	_	Destroyed	0-25%	No teeth present (Postmortem loss)
T07 PEEP2 LA	35-48	Male	_	76.3	Moderate	25-75%	Nearly complete dentition
T08 PEEP2 LA	28-32	Female	150.06	58.9	Moderate	75-100%	Nearly complete dentition
T09 PEEP2 LA	Unknown	Unsexed	_	_	Destroyed	0-25%	No teeth present (Postmortem loss)
T10 PEEP2 LA	5-6	Unsexed	_	_	Moderate	25-75%	Nearly complete dentition
T11 PEEP2 LA	40-50	Male	_	74.3	Good	25-75%	Nearly complete dentition
T12 PEEP2 LA	30-35	Male	_	_	Moderate	25-75%	Nearly complete dentition
T13 PEEP2 LA	Unknown	Unsexed	_	_	Destroyed	0-25%	No teeth present (Postmortem loss)
T14 PEEP2 LA	50+	Male	_	72.4	Good	25-75%	Complete
T15 PEEP2 LA	17-20	Probable female	_	58.9	Moderate	25-75%	Nearly complete dentition
T16 PEEP2 LA	Unknown	Unsexed	_	_	Destroyed	0-25%	No teeth present (Postmortem loss)
T17 PEEP2 LA	30-35	Probable female	_	54.8	Poor	25-75%	Complete
T18 PEEP2 LA	50+	Female	152.01	55.8	Moderate	25-75%	Nearly complete dentition
T19 PEEP2 LA	50+	Female	_	61.0	Good	75-100%	Nearly complete dentition
T20 PEEP2 LA	45-50	Male	163.27	72.8	Good	75-100%	Nearly complete dentition
T21 PEEP2 LA	20-25	Unsexed	_	_	Destroyed	0-25%	Partial dentition
T22 PEEP2 LA	33-44	Male	_	_	Moderate	0-25%	Partial dentition
T27 PEEP2 LA	36-40	Female	153.37	60.7	Good	25-75%	Complete
T28 PEEP2 LA	20-25	Male	_	71.8	Good	25-75%	Nearly complete dentition
T29 PEEP2 LA	28-32	Female	_	_	Poor	25-75%	Nearly complete dentition
T30 PEEP2 LA	44-50	Female	153.17	58.8	Good	75-100%	Partial dentition
T31 PEEP2 LA	18-22	Male	_	66.2	Good	25-75%	Nearly complete dentition
T32 PEEP2 LA	18-20	Female	_	59.1	Good	75-100%	Complete

Individual	Age ranges	Sex	Stature (cm)	Body mass (kg)	Bone surface preservation	Skeletal completeness	Dental completeness
T33 PEEP2 LA	4-4	Unsexed	_		Poor	0-25%	Partial dentition
T34 PEEP2 LA	30-35	Probable male	168.35	64.2	Good	75-100%	Nearly complete dentition
T36 PEEP2 LA	1-2	Unsexed	_	_	Destroyed	0-25%	Nearly complete dentition
T38 PEEP2 LA	28-35	Male	_	68.1	Moderate	25-75%	Partial dentition
T39 PEEP1 LA	28-35	Male	166.09	82.4	Good	75-100%	Nearly complete dentition
T39 PEEP2 LA	17-18	Female	_	53.6	Moderate	25-75%	Nearly complete dentition
T4 CORO LA	20-26	Unsexed	_	_	Poor	0-25%	Partial dentition
T40 PEEP1 LA	45-50	Female	154.34	59.2	Moderate	25-75%	Nearly complete dentition
T41 PEEP2 LA	4-4	Unsexed	_	_	Poor	0-25%	Nearly complete dentition
T42 PEEP2 LA	50+	Female	_	_	Good	25-75%	Nearly complete dentition
T43 PEEP1 LA	50+	Female	_	_	Moderate	25-75%	Nearly complete dentition
T43 PEEP2 LA	28-30	Male	170.98	72.7	Good	75-100%	Complete
T5 CORO LA	18-20	Ambiguous	_	52.1	Moderate	25-75%	Nearly complete dentition
T55 PEEP1 LA	3-4	Unsexed	_	_	Poor	25-75%	Nearly complete dentition

Moscufo-Via Petrarca cemetery

Individual	Age ranges	Sex	Stature (cm)	Body mass (kg)	Bone surface preservation	Skeletal completeness	Dental completeness
MOS VP C3-1	18-20	Male	157.8	51.73	Poor	0-25%	No teeth present (Postmortem loss)
MOS VP T01	20-25	Unsexed	_	_	Destroyed	0-25%	Partial dentition
MOS VP T02	24-32	Male	–	–	Poor	25-75%	Partial dentition
MOS VP T03	Unknown	Unsexed	–	–	Poor	0-25%	No teeth present (Postmortem loss)
MOS VP T05	Unknown	Probable female	–	–	Poor	0-25%	No teeth present (Postmortem loss)
MOS VP T06	17-18	Probable male	–	–	Moderate	25-75%	Nearly complete dentition
MOS VP T07	50+	Female	–	–	Poor	25-75%	Partial dentition
MOS VP T08	25-28	Male	164.0	67.94	Moderate	25-75%	Complete
MOS VP T13	28-32	Probable female	–	–	Poor	0-25%	Partial dentition
MOS VP T15	50+	Male	–	66.42	Moderate	25-75%	Nearly complete dentition
MOS VP T16	15-17	Unsexed	–	_	Moderate	25-75%	Partial dentition
MOS VP T19	15-19	Female	–	61.68	Moderate	0-25%	No teeth present (Postmortem loss)
MOS VP T20	17-18	Female	154.7	61.94	Good	25-75%	Nearly complete dentition
MOS VP T21	15-18	Female	154.5	57.87	Good	25-75%	Nearly complete dentition
MOS VP T22	50+	Male	_	58.28	Moderate	0-25%	Partial dentition
MOS VP T24	48-50	Female	157.1	57.80	Moderate	25-75%	Nearly complete dentition

Individual	Age ranges	Sex	Stature (cm)	Body mass (kg)	Bone surface preservation	Skeletal completeness	Dental completeness
MOS VPC3-2	Unknown	Male	–	–	Poor	0-25%	No teeth present (Postmortem loss)
MOS VPC3-3	Unknown	Male	–	–	Good	25-75%	No teeth present (Postmortem loss)
MOSC VPETR ?T16	39-45	Probable male	–	56.45	Moderate	25-75%	Nearly complete dentition

Spoltore-Quagliera cemetery

Individual	Age ranges	Sex	Stature (cm)	Body mass (kg)	Bone surface preservation	Skeletal completeness	Dental completeness
T1 QUASP	20-25	Probable female	_	_	Moderate	0-25%	Nearly complete dentition
T2 QUASP	8-11	Unsexed	–	–	Poor	0-25%	No teeth present (Postmortem loss)
T4 QUASP	35-45	Male	_	76.27	Moderate	25-75%	Nearly complete dentition
T5 QUASP	18-22	Male	167.79	72.95	Moderate	25-75%	Nearly complete dentition
T6 QUASP	12-15	Unsexed	–	–	Poor	0-25%	Complete
T7 QUASP	12-12	Unsexed	–	–	Poor	0-25%	Nearly complete dentition
T8 QUASP	40-50	Female	_	57.18	Moderate	0-25%	Nearly complete dentition
T9 QUASP	18-20	Probable male	166.28	62.99	Moderate	25-75%	Complete
T10 QUASP	18-22	Probable male	–	66.76	Moderate	75-100%	Complete
T11 QUASP	50+	Probable female	–	_	Moderate	0-25%	Nearly complete dentition
T12 QUASP	26-32	Female	156.09	60.75	Moderate	25-75%	Nearly complete dentition
T13 QUASP	50+	Female	–	–	Poor	0-25%	No teeth present (Postmortem loss)
T15 QUASP	26-35	Male	164.59	66.16	Good	25-75%	Complete
T16 QUASP	26-28	Male	–	56.04	Moderate	0-25%	Complete
T17 QUASP	18-20	Male	–	_	Moderate	25-75%	Complete
T18 QUASP	25-28	Male	–	70.27	Moderate	25-75%	Nearly complete dentition
T19 QUASP	25-28	Probable male	–	–	Poor	25-75%	Nearly complete dentition
T20 QUASP	18-20	Female	–	–	Moderate	25-75%	Nearly complete dentition
T21 QUASP	50+	Female	–	–	Poor	25-75%	Nearly complete dentition
T22 QUASP	36-40	Male	–	68.97	Moderate	25-75%	Complete

Individual	Age ranges	Sex	Stature (cm)	Body mass (kg)	Bone surface preservation	Skeletal completeness	Dental completeness
T23 QUASP	36-50	Male	–	–	Moderate	25-75%	Complete
T24 QUASP	28-35	Male	–	–	Good	75-100%	Complete
T25 QUASP	24-28	Female	–	–	Moderate	25-75%	Nearly complete dentition
T27 QUASP	18-25	Female	–	68.97	Moderate	25-75%	Complete
T28 QUASP	30-35	Male	–	–	Moderate	25-75%	Complete
T30 QUASP	17-18	Male	–	–	Moderate	25-75%	Nearly complete dentition
T32 QUASP	36-44	Female	–	–	Moderate	25-75%	Nearly complete dentition
T33 QUASP	50+	Female	–	–	Poor	0-25%	Partial dentition
T34 QUASP	35-40	Female	155.31	58.32	Good	75-100%	Nearly complete dentition
T35 QUASP	36-44	Probable male	–	68.14	Moderate	25-75%	Nearly complete dentition
T36 QUASP	28-35	Male	166.85	68.95	Good	75-100%	Complete

Appendix B – Funerary Deposition Data

This Appendix contains the data concerning the funerary deposition for the five cemeteries included in this thesis. The data are reported in the following order:

- Loreto Aprutino-Cappuccini;
- Moscufo-Via Petrarca;
- Spoltore-Quagliera;
- Pescara-Ex Gesuiti;
- Nocciano.

The tables reported below include information regarding the single burials. The burial number is showed on the same row of the period in which the individual was buried, age and sex of the individual as determined during the data collection, type of burial and dimensions, grave goods, year of excavation and additional observation.

Loreto Aprutino-Cappuccini funerary deposition data

Burial number	Period	Age	Sex	Type of burial	Burial dimension	Grave goods	Year of excavation	Observations
T39 PEEP1	First half of 5th century BC	28-35	Male	*Fossa* grave -rectangular shape. Orientation EW. Burial with no cover. Niche present (right side of the deceased near the feet) with *olla*. Well preserved skeleton, supine position with arms along the sides	External rectangular grave length: 216cm; internal layer length: 160cm; max width: 70cm, internal width: 35cm; deep: 173 cm (ground level to floor of the burial), 143cm (ground level to the *olla* and the spear layer)	Large *olla* -coarse ware-; iron spearhead; Iron sword with cross guard; iron ferrule; iron element -ring shape-; long iron spit; iron nail; several iron nails and several bronze rivets; *kantharos* -bucchero ware-; cup -impasto-; 2 *ollae* -fine ware-	1999-2002	–
T40 PEEP1	First half of 5th century BC	45-50	Female	*Fossa* grave -rectangular shape. Orientation EW, parallel to T39. well preserved skeleton in supine position with arms along the sides	External rectangular grave length: 215cm; internal layer length: 188cm; max width: 80cm, internal width: 40cm; deep: 115 cm (ground level to floor of the burial) 104cm (from the external grave to the first layer)	Bronze fibula -swollen arch-; iron fibula -undulating arch-; 2 truncated spindle-whorls; cup -impasto-; cup -fine ware-; mug -fine ware-; cup -impasto-; cup -coarse ware-	1999-2002	–
T43 PEEP1	End 5th century BC	50+	Female	*Fossa* grave -rectangular shape. Orientation SE-NW. Well preserved skeleton in supine position with arms along the sides. *Olla* half way up the wall of the burial near the deceased feet	External rectangular grave length: 255cm, internal layer length: 184cm; max width: 89cm, internal width: 40cm; deep: 161cm (ground level to floor of the burial), 126cm (ground level to the level of the *olla*)	Large *olla* -coarse ware- with applique; 2 iron fibulae -simple arch-; cup -fine ware-; small jug -fine ware-; small *olla* -fine ware-	1999-2002	–
T55 PEEP1	6th-5th century BC	3-4	Unsexed	*Fossa* grave with rim of stones. Orientation EW. Skeleton in supine position with arms along the sides	Length: 55cm; max width: 37cm; deep: 27cm (ground level to floor of the burial)	Mug -fine ware-; cup -fine ware-; small jug -fine ware-; iron fibula -simple arch - with a stone pendant; necklace of amber -cylindrical and drop shape- and bone beads -circular and squared shape-; bronze, iron	1999-2002	–

Burial number	Period	Age	Sex	Type of burial	Burial dimension	Grave goods	Year of excavation	Observations
						and bone beads linked to the necklace; tweezers		
T63 PEEP1	6th-5th century BC	–	–	*Fossa* grave. Orientation EW, No skeleton	Length: 126cm; max width: 27cm; deep: 24cm (ground level to floor of the burial)	*Kantharos* -impasto bucchero-; iron fibula with bronze rings pendant	1999-2002	–
T64 PEEP1	6th-5th century BC	–	–	*Fossa* grave. Orientation EW, No skeleton	Length: 174cm; max width: 38cm; deep: 80cm (ground level to floor of the burial) 28cm (from deposition level to first layer of the *fossa)*	Iron dagger; *olla* -fine ware-; bronze basin	1999-2002	–
T65 PEEP1	6th-5th century BC	–	–	–	–	–	1999-2002	–
T1 COROLONGO	First half of 5th century BC	–	–	*Fossa* grave. Orientation SW-NE. Grave filled with soil and stones. Skeleton in supine position with arms along the sides.	Length: 177cm; width: 45cm, internal width: 40cm; deep: 14cm (ground level to floor of the burial)	Iron fibula -simple arch-; iron spit; iron dagger; shoes with wooden sole, iron nails and iron fragments of shoe edges -crampons-	1999-2002	–
T2 COROLONGO	First half of 5th century BC	–	–	*Fossa* grave. orientation SW-NE. Skeleton in supine position, arms along the sides.	Residual length: 80cm; max width: 34cm; deep: 9cm (from ground level)	2 iron fibulae -simple arch-	1999-2002	–
T3 COROLONGO	6th-5th century BC	–	–	*Fossa* grave on higher level than T1-T2. Fragmented.	Residual length: 25cm; max width: 30cm; deep: 10cm (from ground level)	Fragmented bowl -fine ware-	1999-2002	–
T4 COROLONGO	First half of 5th century BC	20-26	Unsexed	*Fossa* grave with rim of stones. Orientation EW. Skeleton in supine position with arms along the sides. Grave covered with stones	Residual length: 180cm; max width: 60cm; deep: 52cm (from ground level to fool of the burial)	Large *olla* -half way up the wall of the burial-; bronze fibula; small bronze fibula -simple arch-, small bronze fibula -; small jug -fine ware-; bowl -impasto-; small *olla* -coarse ware-; amber and glass paste beads	1999-2002	–
T5 COROLONGO	First half of 5th century BC	18-20	Ambiguous	*Fossa* grave	Residual length: 110cm; max width: 37cm; deep: 12cm (from ground level to floor of the burial)	Iron fibula -simple arch-; iron fibula -simple arch-	1999-2002	–
T6 COROLONGO	6th-5th century BC	–	–	*Fossa* grave, completely damaged, no skeleton	Residual length: 24cm; max width: 30cm; deep: 9cm (from ground level to floor of the burial)	Cup -fine ware-	1999-2002	–

Burial number	Period	Age	Sex	Type of burial	Burial dimension	Grave goods	Year of excavation	Observations
T1 PEEP2	First half of 5th century BC	–	–	*Fossa* grave -anthropomorphic shape-skeleton in supine position, left arm along the side right arm bent on the pelvis, legs out straight, oriented NE/SW. *Olla* on upper layer	Length: 210cm; width: 50cm; deep: 75cm	Large *olla* -coarse ware-; cup -fine ware-; small *olla*-fine ware-; 2 large iron fibulae -simple arch-; bronze fibula; amber pendant; iron fibula linked to a bronze ring and a bronze pendant; globular flask -bucchero ware-	1999-2002	–
T2 PEEP2	First half of 5th century BC	–	–	Damaged deposition	–	Cup -coarse ware-; cup -coarse ware-; 2 bronze fibulae -simple arch-; iron fibula; small mug -coarse ware-; bronze ring; bronze chain link	1999-2002	–
T3 PEEP2	First half of 5th century BC	–	–	*Fossa* grave -anthropomorphic shape-; damaged skeleton. *Olla* half way up the burial wall	Length: 150cm; width: 40cm; deep: 60cm	Large *olla* -fine ware-; *olla* -coarse ware-; iron sword; small jug -impasto bucchero -; cup -impasto bucchero-	1999-2002	–
T4 PEEP2	First half of 5th century BC	Unknown	Unsexed	*Fossa* grave -anthropomorphic shape-damaged skeleton	Length: 150cm; width: 40-50cm; deep: 78cm	Small *olla* -coarse ware-; necklace made of glass paste beads; amber beads; cup -coarse ware-; cup -fine ware; small jug or *kantharos* -bucchero impasto-; small mug -impasto-; bronze fibula -simple arch- with a double interlock knit small bronze chain; iron fibula; finger ring	1999-2002	Infant burial (from published report)
T5 PEEP2	6th-5th century BC	Unknown	Unsexed	*Fossa* grave -anthropomorphic shape-damaged skeleton, grave covered with stones	Length: 152cm; width: 60cm; deep: 5cm (from stone cover) and 30cm (from the cover to the floor of the burial)	2 iron fibulae -undulating arch -, one linked to a stone disk pendant by bronze rings; a rectangular object made of iron highly corroded; cup -*impasto*-	1999-2002	Infant burial (from published report)
T6 PEEP2	First half of 5th century BC	Unknown	Unsexed	Damaged deposition	–	Cup -fine ware; small jug or *kantharos* -bucchero ware-; small jug -coarse ware-; bronze fibula -swollen arch -, one linked to a bronze tweezer with a bronze ring; 2 rings (bronze and iron) iron fibula; necklace with 6 glass paste beads; bronze fibula -simple arch-; bronze fibula -simple arch- with tweezer and ring pendants	1999-2002	Infant burial (from published report)
T7 PEEP2	6th-5th century BC	35-48	Male	*Fossa* grave -anthropomorphic shape-skeleton in anatomical position. Orientation NE/SW. *Olla* half way up	Length: 234cm; width: 65cm; deep: 100cm (from the cover) 160cm (from the	Large *olla -applique-;* iron dagger; iron spit; *kantharos*; bowl -bucchero ware-; large cup	1999-2002	–

Burial number	Period	Age	Sex	Type of burial	Burial dimension	Grave goods	Year of excavation	Observations
				the wall of the burial in a niche surrounded by stones	cover to the floor of the burial)	with one handle and spout -impasto-; cup -impasto-		
T8 PEEP2	First half of 5^{th} century BC	28-32	Female	*Fossa* grave -anthropomorphic shape-; skeleton in anatomical position, supine with right arm along the side, left arm slightly bent on the hip, legs out straight, orientation NE/SW. grave surrounded by stones. *Olla* half way up the wall of the burial, in a niche surrounded by stones	Length: 160cm; width: 35cm; deep: 105cm (from the cover) 195cm (from the cover to the floor of the burial)	Large *olla* -coarse ware- (OF in a stone niche); small stamnoid *olla* -fine ware-; jug -coarse ware- inside the large *olla*-; cup -fine ware-; small vessel -coarse ware-; line of bronze rings -dress ornament-; 2 bronze fibulae -simple arch-, one linked with an iron fibula; iron fibula linked to a disk-bone pendant by bronze rings; pear-shaped spindle whorl; glass beads; bronze tweezer; isolated glass paste bead	1999-2002	–
T9 PEEP2	6^{th}-5^{th} century BC	Unknown	Unsexed	*Fossa* grave -anthropomorphic shape- damaged skeleton	Length: 120cm; width: 40cm; deep: 70cm	Cup -coarse ware-; small *olla* -coarse ware-	1999-2002	Infant burial (from published report)
T10 PEEP2	6^{th}-5^{th} century BC	5-6	Unsexed	*Fossa* grave -anthropomorphic shape-, skeleton in supine position, arms along the sides, legs out straight, orientation NE/SW. Small *olla* -impasto bucchero- half way up to the burial wall, protected by stones	Length: 120cm; width: 35cm; deep: 50cm	*Olla* -impasto bucchero- (surrounded by stones); 3 iron fibulae -simple arch-; 2 iron fibulae; a bronze fibula -simple arch-; small jug -fine ware- (inside a cup); cup -fine ware-; small amphora -coarse ware- small mug -coarse ware-; bronze ring	1999-2002	–
T11 PEEP2	6^{th}-5^{th} century BC	40-50	Male	*Fossa* grave -anthropomorphic shape-, skeleton in anatomical position, left arm along the side right arm bent on the pelvis, legs out straight. Orientation NE/SW. *Olla* half way up the burial wall, in a niche surrounded by stones	Length: 210cm; width: 70cm; deep: 100cm	Large *olla* -fine ware-; iron ring and small nails; shield in organic material (?); large cup -fine ware-; razor inside the cup; cup -fine ware-; long iron spit; long iron sword; iron spearhead; cup -fine ware-	1999-2002	–
T12 PEEP2	6^{th}-5^{th} century BC	30-35	Male	*Fossa* grave -anthropomorphic shape-, skeleton in supine position in anatomical position, arms along the sides, legs out straight. Orientation NE/SW. *Olla* half way up the wall of the burial, protected by few stones	Length: 200cm; width: 40cm; deep: 125cm	Large *olla* -fine ware-; small *olla* -cylindrical shape-; razor inside a small *olla*; iron ferrule; iron fibula -simple arch; a bronze ring; cup with one handle -fine ware-; iron spit	1999-2002	–

Burial number	Period	Age	Sex	Type of burial	Burial dimension	Grave goods	Year of excavation	Observations
T13 PEEP2	6^{th}-5^{th} century BC	Unknown	Unsexed	*Fossa* grave -anthropomorphic shape-, completely damaged. Orientation NE/SW	Length: 160cm; width: 58cm; deep: 85cm	–	1999-2002	–
T14 PEEP2	End 5^{th} beginning 4^{th} BC	50+	Male	*Fossa* grave -anthropomorphic shape-, skeleton in supine position in anatomical position, right arm along the side, left arm bent on the pelvis, legs out straight. Orientation NE/SW. *Olla* half way up the wall of the burial, without protection	Length: 190cm; width: 50cm; deep: 175cm	Large *olla* - 3 appliques- (fine ware); iron spearhead; 3 iron spits; 2 iron fibulae -simple arch -; cup -fine ware-; *skyphos* -black paint- (Morel4383) inside the *olla*	1999-2002	–
T15 PEEP2	6^{th}-5^{th} century BC	17-20	Probable female	*Fossa* grave -anthropomorphic shape; slightly turned on the left side, arms and legs slightly flexed towards left. Orientation NE/SW	Length: 200cm; width: 70cm; deep: 85cm	Line of bronze rings -dress ornament- linked to 2 circular pendant; linked also to 2 circular elements; disk made of bone; 2 Cypraea shells and 2 cylindrical bronze beads; 3 bronze bullae and 3 cylindrical beads; 2 iron fibulae and a bronze fibula; spindle whorl; several squared amber beads; several small beads -various shapes-; necklace made of glass paste and amber beads; cup -fine ware-	1999-2002	–
T16 PEEP2	6^{th}-5^{th} century BC	Unknown	Unsexed	*Fossa* grave -anthropomorphic shape-, completely damaged. Orientation NE/SW	Length: 140cm; width: 40cm; deep: 40cm	–	1999-2002	–
T17 PEEP2	6^{th}-5^{th} century BC	30-35	Probable female	*Fossa* grave -anthropomorphic shape-; skeleton in supine position, left arm along the side, right arm bent on the pelvis, legs out straight. Orientation NE/SW. *Olla* without protection	Length: 190cm; width: 55cm; deep: 80cm	Large *olla* -coarse ware-; *olla* -impasto-; iron fibula -undulating arch-; Iron fibula; 2 bronze fibulae -simple arch-; starred shaped spindle-whorl	1999-2002	–
T18 PEEP2	6^{th}-5^{th} century BC	50+	Female	*Fossa* grave -anthropomorphic shape-, skeleton in supine position, right arm along the side, left arm bent on the pelvis, legs out straight. Orientation NE/SW, grave surrounded by stones. *Olla* on upper layer	Length: 190cm; width: 50cm; deep: 80cm	Large *olla* -coarse ware-; truncated cone shaped spindle whorl; jug -fine ware-; cup -fine ware-; truncated cone shaped vessel -coarse ware-; bronze fibula with ring pendant; bronze fibula with bronze spiral pendant	1999-2002	–
T19 PEEP2	6^{th}-5^{th} century BC	50+	Female	*Fossa* grave -rectangular shape-, skeleton in supine position with arms	–	Large *olla*; 2 iron fibulae with a circular stone pendant and a bronze ring; necklace	1999-2002	–

Burial number	Period	Age	Sex	Type of burial	Burial dimension	Grave goods	Year of excavation	Observations
				along the sides and legs out straight, oriented NE/SW with skull or. NE, grave filled up with soil. *Olla* half way up the wall of the burial and protected by several stones		made of glass paste and amber beads; 3 glass paste beads; cup with one handle -purified clay-		
T20 PEEP2	6^{th}-5^{th} century BC	45-50	Male	*Fossa* grave -rectangular shape-, skeleton in supine position with arms along the sides and legs out straight, orientation NE/SW. *Olla* half way up the wall of the burial protected by several stones.	–	Large *olla* -impasto clay-; Iron fibula -simple arch-; iron spit; shoes with wooden sole, iron nails and iron fragments of shoe edges -crampons-; iron sward; cup with double handles -purified clay-; razor inside the cup	1999-2002	–
T21 PEEP2	6^{th}-5^{th} century BC	20-25	Unsexed	*Fossa* grave -anthropomorphic shape-, skeleton in supine position with arms along the sides and legs out straight, grave covered with large stones. Large *olla* half way up the burial wall in a niche surrounded by stones.	–	Large *olla*, iron fibula -simple arch- and 2 bronze rings; bronze fibula -simple arch- with small bronze rings; necklace made of glass paste and amber beads; isolated glass paste beads; bronze basin	1999-2002	–
T22 PEEP2	6^{th}-5^{th} century BC	33-44	Male	*Fossa* grave -rectangular shape-, skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW. Grave surrounded by stones.	–	Iron ferrule; iron spear -leaf shape-; 2 fibulae -simple arch-	1999-2002	–
T23 PEEP2	6^{th}-5^{th} century BC	–	–	–	–	–	1999-2002	–
T24 PEEP2	6^{th}-5^{th} century BC	–	–	*Fossa* grave -anthropomorphic shape-, skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW.	–	Iron dagger	1999-2002	–
T25 PEEP2	6^{th}-5^{th} century BC	–	–	*Fossa* grave -anthropomorphic shape- skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW	–	–	1999-2002	Infant burial (from published report)
T26 PEEP2	–	–	–	–	–	–	1999-2002	–
T27 PEEP2	6^{th}-5^{th} century BC	36-40	Female	*Fossa* grave -rectangular shape-, skeleton in supine position with arms along the sides and legs out straight.	–	Large *olla*, spindle-whorl	1999-2002	–

Burial number	Period	Age	Sex	Type of burial	Burial dimension	Grave goods	Year of excavation	Observations
				Orientation NE/SW. *Olla* half way up the wall of the burial, in a niche surrounded by stones				
T28 PEEP2	6^{th}-5^{th} century BC	20-25	Male	*Fossa grave* -rectangular shape-, skeleton in supine position with arms on the pelvis and of the sword guard, and legs out straight. Orientation NE/SW. *Olla* half way up the burial wall, in a niche surrounded by stones	–	Large *olla*; long sword; iron ring with small nails plus iron fragments of the cross guard; *olla* -purified clay-; cup -purified clay-; *olpe* -bucchero ware- inside the *olla*	1999-2002	–
T29 PEEP2	6^{th}-5^{th} century BC	28-32	Female	*Fossa* grave -anthropomorphic shape-, skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW	–	–	1999-2002	–
T30 PEEP2	6^{th}-5^{th} century BC	44-50	Female	*Fossa* grave -anthropomorphic shape-, skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW. *Olla* half way up the burial wall in a niche surrounded by stones	–	Large *olla;* isolated glass paste beads	1999-2002	–
T31 PEEP2	6^{th}-5^{th} century BC	18-22	Male	*Fossa* grave -anthropomorphic shape-, skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW	–	*Olla* without niche; shield in organic material (?); sword ; bronze vessel; iron spit; cup -purified clay-; spearhead; bronze basin	1999-2002	–
T32 PEEP2	6^{th}-5^{th} century BC	18-20	Female	*Fossa* grave -anthropomorphic shape-, skeleton in supine position with arms along the sides and legs out straight. Oriented NE/SW	–	Line of bronze rings -dress ornament-, 2 iron fibulae, 2 large cylindrical bone beads, bronze pendant encrusted with bone (ON)	1999-2002	–
T33 PEEP2	6^{th}-5^{th} century BC	4-4	Unsexed	*Fossa* grave -anthropomorphic shape-, skeleton in supine position with arms along the sides and legs out straight. Oriented NE/SW	–	*Torques* around the neck; cup with one handle -purified clay-	1999-2002	–
T34 PEEP2	6^{th}-5^{th} century BC	30-35	Probable male	*Fossa* grave -anthropomorphic shape-, skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW. *Olla* half way up the burial wall protected by few stones	–	Large *olla*; iron spear; iron dagger; iron spit; globular flask -bucchero ware-; cup -purified clay-; cup with one handle -purified clay-	1999-2002	–

Burial number	Period	Age	Sex	Type of burial	Burial dimension	Grave goods	Year of excavation	Observations
T35 PEEP2	6^{th}-5^{th} century BC	–	–	*Fossa* grave -anthropomorphic shape- , skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW	–	Isolated glass paste beads (ON); 2 iron fibulae -simple arch- (OSH); cup with one handle -purified clay- (OF); small *olla* (OF)	1999-2002	Infant burial (from published report)
T36PEEP2	6^{th}-5^{th} century BC	1-2	Unsexed	*Fossa* grave -anthropomorphic shape-, skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW	–	Isolated glass-paste beads	1999-2002	
T37 PEEP2	6^{th}-5^{th} century BC	–	–	*Fossa* grave, -anthropomorphic shape-, skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW	–	Isolated glass-paste beads; small *olla*	1999-2002	Infant burial (from published report)
T38 PEEP2	6^{th}-5^{th} century BC	28-35	Male	*Fossa* grave, -anthropomorphic shape-, skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW	–	Bronze ring	1999-2002	–
T39 PEEP2	6^{th}-5^{th} century BC	17-18	Female	*Fossa* grave, -anthropomorphic shape-, skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW	–	3 iron fibulae; bronze tweezer; large bronze fibula	1999-2002	–
T40 PEEP2	6^{th}-5^{th} century BC	–	–	*Fossa* grave -triangular shape-, skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW. *Olla* half way up the wall of the burial, without protection	–	Large *olla;* iron spear; iron dagger; iron spit; globular flask -bucchero ware-; cup with two handles decorated with parallel ribs, vertical handles decorated with palm motives	1999-2002	–
T41 PEEP2	6^{th}-5^{th} century BC	4-4	Unsexed	*Fossa* grave -anthropomorphic shape-, skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW. Small *olla* -impasto bucchero- protected by stones	–	Small *olla* -bucchero ware-; cup with one handle -purified clay-; 2 iron fibulae	1999-2002	–
T42 PEEP2	6^{th}-5^{th} century BC	50+	Female	*Fossa* grave -anthropomorphic shape- skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW. *Olla* half way up	–	Large *olla*; small *olla*; dipper into the large *olla*; cup with one handle -purified clay-	1999-2002	–

Burial number	Period	Age	Sex	Type of burial	Burial dimension	Grave goods	Year of excavation	Observations
				the wall of the burial, protected by few stones				
T43 PEEP2	6th-5th century BC	28-30	Male	*Fossa* grave -rectangular shape-, skeleton in supine position with arms along the sides and legs out straight. Orientation NE/SW *Olla* half way up the burial wall, on top of a small stone wall	–	large *olla*; iron spear; culter; fragmented iron fibula -simple arch-; iron spit; large cup -bucchero ware- with everted rim; small *olpe* -bucchero ware-	1999-2002	–
T44 PEEP2	6th-5th century BC	–	–	*Fossa* grave -anthropomorphic shape-, skeleton in supine position with arms along the sides and legs out straight. Oriented NE/SW	–	–	1999-2002	–
T45 PEEP2	6th-5th century BC	–	–	–	–	–	1999-2002	–
T46 PEEP2	6th-5th century BC	–	–	–	–	–	1999-2002	–
T47 PEEP2	6th-5th century BC	–	–	–	–	–	1999-2002	–
T48 PEEP2	6th-5th century BC	–	–	*Fossa* grave, skeleton supine, right arm beside the body. Orientation NW-SE	Length: 160cm; width: 60cm	Bronze ring; one bronze fibula -Loreto Type-; one iron fibula -undulating arch-	1999-2002	–
T49 PEEP2	–	–	–	*Fossa* grave, covered with large stones, skeleton poorly preserved. Oriented NW-SE	Length: 160cm; width: 70cm	No objects	1999-2002	–
T50 PEEP2	–	–	–	*Fossa* grave, skeleton absent. Oriented NE-SO	Length: 200cm; width: 60cm	No objects	1999-2002	–
T51 PEEP2	–	–	–	*Fossa* grave, covered with large stones. Oriented NW-SE. Skeleton absent	Length: 200cm; width: 60cm	No objects	1999-2002	–

Moscufo-Via Petrarca funerary deposition data

Burial number	Period	Age	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Comments
T1	Second half of 6th -5th century BC	20-25	Unsexed	*Fossa* grave. *Olla* half way up the wall of the burial	–	Small *olla*; long iron sword with cross guard	2008	–
T2	Second half of 6th -5th century BC	24-38	Male	*Fossa* grave. *Olla* half way up the wall of the burial	–	large *olla*; long iron sword with cross guard	2008	–
T3	Second half of 6th -5th century BC	Unknown	Unsexed	*Fossa* grave. *Olla* on burial floor	–	Large *olla*; iron razor; long iron sword; cup; bronze fibula	2008	–
T4	7th BC-first half 6th century BC	No skeleton	No skeleton	*Fossa* grave	–	2 *ollae;* jug -Impasto ware- into the *olla*e*;* 3 small cups, jug -coarse ware-; fragments of iron fibula; bronze fibula -Loreto Aprutino type-	2008	–
T5	Second half of 6th -5th century BC	Unknown	Probable female	*Fossa* grave	–	–	2008	–
T6	Second half of 6th -5th century BC	17-18	Probable male	*Fossa* grave	–	Long Iron sword with cross guard	2008	–
T7	Second half of 6th -5th century BC	50+	Female	*Fossa* grave. *Olla* half way up the wall of the burial (niche)	–	2 large *olla*e, 2 Jugs -coarse ware- into the first *olla*; 2 jugs -impasto ware- inside the second *olla*; 2 bronze fibulae -simple arch-; spindle whorl; fragmented small bowl -impasto ware-	2008	–
T8	Second half of 6th -5th century BC	25-28	Male	*Fossa grave. Olla half way up the wall of the burial*	–	Large *olla*; iron razor; large plate	2008	–

Burial number	Period	Age	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Comments
T9	Second half of 6th -5th century BC	No skeleton	No skeleton	*Fossa* grave	_	2 bronze fibulae -simple arch -, one with a ring linked to the shaft; fragments of 2 iron fibulae; 2 bronze fibulae *Certosa* type-; bronze bracelet ; 2 rings; bronze armilla	2008	Infant burial (from published report)
T10	Second half of 6th -5th century BC	No skeleton	No skeleton	*Fossa* grave	_	*Olla*; jug -fine ware- inside the *olla*-; cup -coarse ware-; fibula *Certosa* type; fibulae -simple arch-; bronze armilla; bronze tweezers; 3 glass paste beads; 3 small bronze rings	2008	Infant burial (from published report)
T11	Second half of 6th -5th century BC	No skeleton	No skeleton	*Fossa* grave	_	*Olla*; jug inside the *olla*; jug-fine ware; necklace made of glass paste and amber; 2 bronze fibulae -simple arch-; bronze armilla; iron fragments; bronze fragments probably decorative bronze foil; iron fragments probably disk element	2008	Infant burial (from published report)
T12	Second half of 6th -5th century BC	No skeleton	No skeleton	*Fossa* grave	_	_	2008	Infant burial (from published report)
T13	Second half of 6th -5th century BC	28-32	Probable female	*Fossa* grave. *Olla* on burial floor	_	Large *olla*; bronze fibula -simple arch-; 2 iron fibulae; bronze pendant;calcareous limestone pendant; bronze rings; cup -coarse ware-	2008	_

Burial number	Period	Age	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Comments
T14	Second half of 6th -5th century BC	No skeleton	No skeleton	*Fossa* grave	_	Fibula -undulating arch-	2008	Infant burial (from published report)
T15	Second half of 6th -5th century BC	50+	Male	*Fossa* grave	_	_	2008	_
T16	Second half of 6th -5th century BC	15-17	Unsexed	*Fossa* grave. *Olla* half way up the burial wall	_	Spindle-whorl	2008	_
T17	Second half of 6th -5th century BC	No skeleton	No skeleton	*Fossa* grave. *Olla* half way up the wall of the burial	_	Large *olla*, jug inside the *olla*; line of bronze rings - dress ornament-	2008	Infant burial (from published report)
T18	Second half of 6th -5th century BC	No skeleton	No skeleton	*Fossa* grave	_	Small *olla*; jug -coarse ware- inside the *olla*; cup	2008	Infant burial (from published report)
T19	Second half of 6th -5th century BC	15-19	Female	*Fossa* grave. *Olla* half way up the burial wall	_	Large *olla*	2008	_
T20	Second half of 6th -5th century BC	17-18	Female	*Fossa* grave. Orientation NE/SO. skeleton supine, arms along the sides and legs straights. *Olla* half way up the wall of the burial	L 155 cm, W 38, D 50	Large *olla*; jug inside the *olla*; 3 simple arch iron *fibula* linked to calcareous limestone pendants, bulla; line of bronze rings - dress ornament- with a glass paste at the end; necklace with bronze cylindrical elements	2008	_
T21	Second half of 6th -5th century BC	15-18	Female	*Fossa* grave. Orientation NE/SO. skeleton supine, arms along the sides and legs straights. *Olla* half way up the wall of the burial	_	Large *olla*; jug inside the *olla*; 2 iron fibulae -simple arch- linked to calcareous limestone pendants; line of bronze rings - dress ornament-; necklace	2008	_

Burial number	Period	Age	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Comments
T22	Second half of 6^{th} -5^{th} century BC	50+	Male	*Fossa* grave. *Olla* on burial floor	–	Large *olla*; long Iron sword with cross guard; bronze large bowl; iron razor	2008	–
T23	Second half of 6^{th} -5^{th} century BC	No skeleton	No skeleton	*Fossa* grave	–	–	2008	Infant burial (from published report)
T24	Second half of 6^{th} -5^{th} century BC	48-50	Female	*Fossa* grave. *Olla* half way up the wall of the burial	–	Large *olla* with dipper; simple arch iron fibulae; bronze rings	2008	–

Spoltore-Quagliera funerary deposition data

Burial number	Period	Age	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Observations
T1	Late 5th / early 4th century BC	20-25	Probable female	*Fossa* grave - rectangular shape, filled up with thin soil. Supine inhumation	145x40 cm	Fragmented krater -fine ware- decorated with red paint Daunian "mixed style"(OF); *skyphos* -black paint- (inside the krater); 2 cups -impasto bucchero-; 1 small cup -fine ware-, *olla* -fine ware-, small bowl -fine ware-, small jug -fine ware- (all yellow ware); bronze digit ring; iron fibula -swollen arch; bronze stud; necklace (bone, amber and stone beads)	2009	–
T2	5th century BC	8-11	Unsexed	*Fossa* grave, supine inhumation; fragmented skeleton (lower limbs preserved only). The niche was occupied by an *olla*, cups, and spearhead	130x40 cm	Large *olla* -red impasto- (half way up the burial wall); 3 small cups -impasto bucchero- with stamps; small vessel -impasto bucchero-; iron spearhead; knife -single edged-; iron spit; small bronze and iron chain; large vessel -fine ware- decorated with bands "mixed style"; bronze stud inside the large vessel	2009	–
T3	5th century BC	–	–	–	–	–	2013	–
T4	5th century BC	35-45	Male	*Fossa* grave	160x190cm	Iron sword -cross guards-; bronze bowl -flat rims-; bronze caldron; Attic stemmed dish; spit; razor; *olla*; knife	2013	–

Burial number	Period	Age	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Observations
T5	5th century BC	18-22	Male	*Fossa* grave	–	Knife -single edged- and tongue-tang long like the blade; *olla*	2013	–
T6	Late 5th / early 4th century BC	12-15	Unsexed	*Fossa* of rectangular shape	–	sword -shorter-; bronze bowl -flat rims-; bronze cauldron -iron handles-; bronze jug; impasto bucchero amphora; razor; group of brooches and claps; group of iron fibulae; large vessel -coarse ware-decorated with bands-two horizontal handles (recall Dauno III), and two pourers- "mixed style"	2013	–
T7	4th century BC	12-12	Unsexed	*Fossa* of rectangular shape	–	Black-glazed *skyphos*	2013	–
T8	5th century BC	40-50	Female	*Fossa* of rectangular shape	–	Bronze comprising of pin ivory ring, a bronze head coupled with a bronze nail	2013	–
T9	5th century BC	18-20	Probable male	*Fossa* of rectangular shape. Supine inhumation. *Olla* half way up the wall of the burial	Deep: 1.90m	76cm tall ovoid *olla* -impasto-(upper level); iron spearhead; 75cm long cross guarded sword; bronze bowl -flat rims-; bronze cauldron; *kardiophylax;* iron spit; small bowl -coarse ware-; small amphora -bucchero?- decorated with stamps; bronze strainer -braided handle-; Attic vessel Black figure cup "skyphos" decorated with palmettes and satyrs; attic vessel "black figure *oinochoe* decorated with owl	2013	–

Burial number	Period	Age	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Observations
T10	5^{th} century BC	18-22	Probable male	*Fossa* of rectangular shape	–	Knife with bone handle -single edged-; bronze bowl; spit; *olla*	2013	Pink layer just above the bones, possibly attesting the presence of thick cloth, leather or fur coverings
T11	5^{th} century BC	50+	Probable female	*Fossa* of rectangular shape	–	4 white lead sticks (?); reel	2013	–
T12	5^{th} century BC	26-32	Female	*Fossa* of rectangular shape	–	Brooches with bronze tweezers and two yellow glass beads with blue eye	2013	–
T13	5^{th} century BC	50+	Female	*Fossa* of rectangular shape	–	Spindle whorl	2013	–
T14	4^{th} century BC	–	–	*Fossa* of rectangular shape	–	Bronze brooches pendants (corals, amber, glass)	2013	Infant burial (from published report)
T15	4^{th} century BC	26-35	Male	*Fossa* of rectangular shape	–	Black-glazed *skyphos* decorated with red palmettes; *olla*	2013	–
T16	4^{th} century BC	26-28	Male	*Fossa* of rectangular shape	–	Long-bladed spearhead	2013	–
T17	Late 5^{th} / early 4^{th} century BC	18-20	Male	*Fossa* of rectangular shape	–	Knife -single blade-; spit; *olla* half way up the wall of the burial	2013	–
T18	Late 5^{th} / early 4^{th} century BC	25-28	Male	*Fossa* of rectangular shape	–	Knife -single blade-; spit; *olla* half way up the wall of the burial; razor	2013	–
T19	5^{th} century BC	25-28	Probable male	*Fossa* of rectangular shape	–	Iron sword -cross guards-; spit; razor	2013	–

Burial number	Period	Age	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Observations
T20	5th century BC	18-20	Female	*Fossa* of rectangular shape	_	_	2013	_
T21	5th century BC	50+	Female	*Fossa* of rectangular shape	_	_	2013	_
T22	4th century BC	36-40	Male	*Fossa* of rectangular shape	_	Knife -double edged-; Jug -impasto bucchero-; *dolium;* spit	2013	_
T23	5th century BC	36-50	Male	*Fossa* of rectangular shape	_	knife -single blade-; *olla*; razor	2013	_
T24	5th century BC	28-35	Male	*Fossa* of rectangular shape	Deep: 2.85m	Iron sword -cross guards-; *dolium* -impasto-; bronze cauldron; razor; knife; spit	2013	_
T25	4th century BC	24-28	Female	*Fossa* of rectangular shape	_	Iron needle; red-banded painted jug; black-glazed *skyphos*; 2 coare ware vessels; necklace (glass and bronze, globe-shaped beads); 2 large iron brooches -bronze pendants (rings, disks, chains, glass beads plain or with eye), left brooch with ivory disc; line of bronze rings -dress ornament-	2013	_
T26	4th century BC	_	_	*Fossa* of rectangular shape	_	Small *olla* -coarse ware-; thin bird bone; two circles (one bronze, one iron)	2013	Infant burial (from published report)
T27	4th century BC	18-25	Female	*Fossa* of rectangular shape	_	Medium *olla* -coarse ware-; necklace of coral and bronze cylindrical beads; bronze armilla; 2 bronze brooches with pendants (elongated, tubular, bulla-type, rings), bell shaped pendants, long chains with Cypraea shell; black-glazed *skyphos* decorated with red palmettes	2013	_

Burial number	Period	Age	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Observations
T28	4th century BC	30-35	Male	*Fossa* of rectangular shape	_	Knife -single edged-; long-bladed spearhead; spit; razor	2013	_
T29	4th century BC	_	_	*Fossa* of rectangular shape	_	Black-glazed *skyphos*; bronze brooches pendants (corals, amber, glass); crafted diadem and necklace coupled with a single Cypraea shell	2013	Infant burial (from published report)
T30	4th century BC	17-18	Male	*Fossa* of rectangular shape	_	*Daunian* "mixed style" *Kantharos*; large globular *olla*; bronze belt; claps and rings; iron brooches; spit; razor	2013	_
T31	4th century BC	_	_	*Fossa* of rectangular shape	_	Bronze torques	2013	Infant burial (from published report)
T32	5th -4th century BC	36-44	Female	*Fossa* of rectangular shape	_	Terracotta reel	2013	_
T33	5th -4th century BC	50+	Female	*Fossa* of rectangular shape	_	Jug roughly decorated with palmettes "mixed style"	2013	_
T34	4th century BC	35-40	Female	*Fossa* of rectangular shape	_	Blue and black banded-painted coarse ware amphora "mixed style"; cup -impasto bucchero-	2013	_
T35	4th century BC	36-44	Probable female	*Fossa* of rectangular shape	_	Knife -single edged-; 2 black -gloss skyphoi; large cup decorated with red bands (recall Dauno III); coarse ware amphora with neck decorated with black and red vegetable motif "mixed style"; dolium -impasto-; long-bladed spearhead; razor; spit	2013	_

Burial number	Period	Age	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Observations
T36	Late 5th / early 4th century BC	28-35	Male	*Fossa* of rectangular shape	–	knife -single edged-;large vessel -coarse ware- decorated with bands-, and two pourers- "mixed style"-; small amphora -impasto bucchero- (Into the vessel); cup -coarse ware; amphora -impasto bucchero-; double handles cup, decorated with red-bands (Dauno III style); *olla* half way the wall of the burial	2013	–

Pescara-Ex Gesuiti funerary deposition data

Burial number	Period	Age (from archaeological report)	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Comments
T1	5th century BC	Unknown	_	*Fossa* grave (-20cm deep) damaged.	Undetermined	Small jug -fine ware, cup coarse ware, small amphora -fine ware-	1997-98	No skeleton
T2	6th century BC	Adult	_	*Fossa* grave with no visible covering layer, partially damaged. Skeleton supine	Length: 25cm; max width: 42cm; deep: 12cm (ground level to burial's floor)	Iron sword with fragmented cross guard; iron spit; fragmented large bronze basin; small bronze basin; razor inside the basin; iron fibula -undulating arch-; fragmented ring with bronze band; cup made of impasto bucchero; short-size bowl -fine ware-	1997-98	No skeleton
T3	6th century BC	Unknown	_	*Fossa* grave -two levels of inhumation. Skelton poor preservation	Length: 166cm; max width: 42cm; deep: 72 cm (ground level to II levels), 64 cm (ground to I level)	I level: large *olla* -coarse ware-; *olla* in -fine ware- painted decorations; 2 iron spits; bronze ring; small bronze *olla;* mug -impasto bucchero- small jug -impasto bucchero - inside the cup; small *olla* -impasto bucchero-; 2 iron fibulae -undulating arch-; large basin; small razor inside the basin; long iron sword with fragmented cross guard; fragments of small bronze stud	1997-98	No skeleton
T4	5th century BC	Adult	_	*Fossa* grave damaged; fragmented bone of the skull	Length: 101cm; max width: 47cm; deep: 32cm (ground level to burial floor) 26cm (from superior margin of the *fossa*)	Spearhead -elongated blade; iron spit; large *olla* -coarse ware-; globular small *olla* -fine ware-; small amphora -impasto bucchero-; cup -fine ware-; iron fragments	1997-98	skeleton of a dog (medium-small size) in a *Fossa*-grave found between T4 and T5 (50/60 cm far from T4)

Burial number	Period	Age (from archaeological report)	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Comments
T5	6th century BC	Unknown	_	*Fossa* grave totally damaged	Residual length: 82cm; max width: 40cm; deep: 32cm (ground level to burial floor) 27cm (from superior margin of the f*ossa*)	Globular *olla* -fine ware-; small jug -impasto bucchero-; cup -impasto-; bronze ring; mug -impasto-decorated with small rings; fragmented iron fibula	1997-98	No skeleton
T6	6th century BC	Adult	_	*Fossa* grave, skeleton highly corroded	Length: 157cm; max width: 57cm; deep: 37cm (ground level to burial floor) 26cm (from superior margin of the *Fossa*)	Bronze fibula -undulating arch -; bronze fibula -swollen arch-; a double interlock knit small bronze chain; line of bronze rings -dress ornament-; 2 bronze armillae; bronze armilla; unknown bronze element (bulla?); cup -fine ware-; small jug -coarse ware-	1997-98	No skeleton
T7	6th century BC	Unknown	_	*Fossa* grave (-20cm deep) damaged; visible fragments of the large *olla*	Residual length: 80cm; max width: 52cm; deep: 20cm (ground level to burial floor)	Fragments of the *olla*	1997-98	No skeleton
T8	6th century BC	Adult	_	*Fossa* grave totally damaged	Undetermined length and width of the *Fossa*	Spearhead; few fragments of the large *olla*	1997-98	No skeleton
T9	6th century BC	Infant	_	*Fossa* grave (-20cm deep) damaged; skeleton highly corroded	Length: 90cm; width: 30cm; deep: 35cm (ground level to burial floor)	Small mug -coarse ware-; small mug -fine ware- with reddish engobe; jug -fine ware-; tweezer and bronze -bulla-; *fibule* -simple arch- and bronze tweezer; necklace of glass-paste beads; bronze fibula -undulated arch-with rings; small bronze tweezer; 4	1997-98	No skeleton

Burial number	Period	Age (from archaeological report)	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Comments
						fragmented iron fibulae; cup -fine ware-; bronze ring; bronze stud		
T10	6th century BC	Adult	–	*Fossa* grave, skeleton highly corroded	Length: 190cm; max width: 64cm; deep: 34cm (ground level to burial floor) 27cm (from superior margin of the *Fossa*)	Line of bronze rings -dress ornament-; bronze fibula -swollen arch-; bronze double-loop hook; large iron fibula -Alfedena type, V c BC-; *olla* -fine ware-; cup -fine ware-; fragments of bone pendants; 6 amber beads	1997-98	No skeleton
T11	6th century BC	Adult	–	*Fossa* grave, skeleton highly corroded	Length: 160cm; max width: 34cm; deep: 38cm (ground level to burial floor) 29cm (from superior margin of the *Fossa*)	Small necklace of bronze foil beads, a Cyprea shells and amber beads; fragments of iron fibulae; fragmented cup -coarse ware-; small *olla* -fine ware-; cup -fine ware-	1997-98	No skeleton

Nocciano funerary deposition data

Burial number	Period	Age (from archaeological report)	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Comments
T1	6^{th} - 5^{th} century BC	Adult	–	Damaged burial. *Fossa* grave covered with three slabs of different dimensions placed at 120cm from the ground level. The slabs were of coarse material, with unregular shape	Length of the skeleton: 165cm; deep: 160cm (ground level to deposition level), 170cm (ground level to the level of the *olla*); 70cm (ground level to first slabs fragments)	Bronze basin with a semi-circular handle (lebete) (diameter: 31cm, height: 13.5cm); fragmented large *olla* -coarse ware- (height: 50cm, diameter: 31cm); two beads of glass paste -millefiori-, one bead of glass paste -dark colour, one bead of glass paste -light colour-, two bronze tubular elements, fragmented iron fibula with long stirrup (7.5cm)	1971-73	No skeleton
T2	6^{th} - 5^{th} century BC	–	–	*Fossa* grave covered with one single slab which appears broken (10-15cm thick) and with unregular shape	Deep: 110cm (from ground level to depositional level); skeleton 150cm long	Fragmented large coarse ware *olla*; fragments of small vessel -impasto bucchero-; long bronze rings ornament (from sternum to end of femora); bronze pendant, bone disk linked to a bronze ring, two iron fibulae	1971-73	No skeleton
T3	6^{th} - 5^{th} century BC	Adult + Immature	–	Multiple inhumation. *Fossa* grave covered with slabs + stones. Female individual + skull of a child oriented NS. Skeletons in a medium state of preservation	Trench dimensions: length: 260cm EO, width: 170cm, deep: 50cm. burial width:105cm; female skeleton length: 165cm; distance from children cranium to the vessels: 50cm; deep: 80cm	Two vessels: one fine ware yellowish colour, the other coarse ware (with wheat remains inside); on the female skeleton two bronze fibulae with rings and pendants, the left one with a glass paste bead; at the bottom of the skeleton of the child: *Oinochoe* -impasto (dark)- *skyphos* -impasto (red)	1971-73	No skeleton
T4	6^{th} - 5^{th} century BC	Immature	–	Infant burial. *Fossa* grave covered with slabs	Deep: 65cm (from ground level to depositional level) orientated EO; skeleton length: 83cm	*Oinochoe* -impasto bucchero-; iron fibulae (6cm) + two glass paste beads; iron fibulae; bronze fibulae + two glass paste beads	1971-73	No skeleton
T5	6^{th} - 5^{th} century BC	–	–	*Fossa* grave covered with a large slab, oriented EO. Good preservation	Lithic slab dimensions: length 200cm, width 65cm. Under the slab around large stones there is	*Olla* - coarse ware- (reddish) (among stones); fine bronze necklace (12cm); two iron fibulae -simple arch- (8cm); necklace made of glass paste beads, prisms, amber and Cypreae shells	1971-73	No skeleton

Burial number	Period	Age (from archaeological report)	Sex	Type of burial	Burial dimensions	Grave goods	Year of excavation	Comments
					the *olla* and a small vessel. Skeleton length: 155cm	(32cm long); bronze ring; fibula -undulating arch-; pendant		
T6	6th - 5th century BC	–	–	*Fossa* grave covered with slab. Oriented NS. Medium preservation	Deep: 130cm (from ground level to depositional level); length of the slab:200cm. The skeleton found 10cm below the slab. The skeleton length: 170cm	Two bowls -one ring shape handle- (yellowish colour) (height: 8.5cm, diameter: 15.5cm), *olla*; iron culter -knife- (length: 26cm); spear (length:220cm, the spearhead length: 27cm); razor (length: 11cm)	1971-73	No skeleton
T7	6th - 5th century BC	–	–	*Fossa* grave covered with stones, oriented NE-SW. skeleton in good preservation	Deep: 95cm (from ground level to depositional level), skeleton length: 150cm. *Olla* placed near the left side of the head	Large vessel (type *olla*) -one horizontal handle and everted rim- (diameter: 13.5cm); vessel-impasto bucchero-; one large and flat ring, and one bronze, thin and small ring; iron fibula (9cm), iron fibula (9cm); glass paste bead, bone pendant with a bronze ring linked to it	1971-73	No skeleton
T8	6th - 5th century BC	–	–	*Fossa* grave covered with stones, oriented NO. a vegetal mat is present at the bottom of the *fossa* below the skeleton. *Olla* upper layer	Deep: 70cm (from ground level to the *olla*), 30cm (from the base of the *olla* to the dep level). Deep:120cm (from ground level to depositional level). Length skeleton: 175cm, width burial: 85cm	Large *olla* -impasto- (upper layer); bronze patera; iron fibula -undulating arch-; iron sword with cross guard covered partially with the mat	1971-73	No skeleton