Health in Southern and Eastern England: a perspective on the early medieval period

Arce, Alvaro Luis

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By

Alvaro Luis Arce
Ustinov College

PhD Thesis
2007
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Declaration

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Abstract

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The aim of this research was to study the health of the Early Medieval population (AD 450- AD1066) in southern and eastern Britain and compare the data to the preceding Romano-British (AD 43 – AD 450) and subsequent Late Medieval (AD 1066 – AD 1600) periods. The data considered in published literature (representing dental disease and stature) (Brothwell, 1961; Wells, 1963; Moore and Corbett, 71, 73, 75; Roberts and Cox, 2003) showed that health improved during the Early Medieval period. In this study, similar results were found. Results show that the prevalence of dental caries by individual and teeth affected decreased from the Romano-British (26.4% of individuals, 7.4% of teeth) to the Early Medieval period (15.4% of individuals, 3.1% of teeth) and then increased again during the Late Medieval period (35.5 % of individuals, 9.0 % of teeth). Stature data showed that male and female stature increased from the Roman-British period (1.68m for males and 1.57m for females) to the Early Medieval period (1.72m for males and 1.63m for females), but decreased during the Late Medieval period (1.71m for males and 1.59 for females).

Data also demonstrated that during the Early Medieval period the rate of enamel hypoplasia increased, and that there was an increased age at death through time. In addition, the rate of cribra orbitalia and tibial periostitis decreased during the Early Medieval period and increased again during the Late Medieval period. Socio-economic contextual data were considered to identify the possible reasons for this trend in health. Aspects of the general living environment, climate, trade, diet and economy, occupation, social status, access to health care, religion and burial practices were studied. The possible reasons for this suggested improvement in health during the Early Medieval period were considered. For example, a diet low in carbohydrates and sugars count for the decrease of dental caries, an increase in the amount of "stress" affecting people was associated to the rise of enamel hypoplasia. On the other hand, a balance diet and introduction of new genes are possible reasons for the increase in stature. In addition, a diet providing enough iron, hygiene, less obesity and less blood loss "episodes" was connected to the decrease of cribra orbitalia. The decrease of tibial periostitis was associated to a strong immune system and fewer injuries. The age at death profile confirmed that most males died at the young adult age and females at the young and middle adult age. The effects of psychological stress on the body were also investigated. The result demonstrated that evidence of mental illness need to be taken in consideration in paleopathological studies. And an alternative hypothesis to the results was also included. Durham 2007.

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Note about table organization and nomenclature: table numbers have been organized first by the chapter number, then by the number that corresponds to the order of appearance in the chapter. In addition tables associated with the dental and skeletal conditions studied had been arranged by stress marker. The number of the table is followed by the letters: DC for Dental Caries, EH for Enamel Hypoplasia, S for Stature, CO for Cribra Orbitalia, TP for Tibial Periostitis and ADP for Age at Death Profile.

List of Figures

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Dedicated to

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Patricia, for all the love, support, help and encouragement that you have given me in good and bad times; you are really amazing… "And the roses and flowers dance because you are one of them; and the birds and the angels sing because you are one of them". I love you.

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Dedicada a

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Chapter 1: Introduction

Before any palaeopathological study can begin it is important to first define what palaeopathology is and also understand its development. In addition, it is relevant to introduce the aims of this study and all the significant elements involved in this research.

1.1 Definition and Development of Palaeopathological Study

Palaeopathology is the study of health and disease in past human populations (Sournia, 1992; Aufderheide and Rodríguez-Martín, 1998; Lovell, 2000). Its scope includes the history and development of diseases, which help in the understanding of diseases of today (Roberts and Cox, 2003; Roberts and Manchester, 2005). More importantly, palaeopathology "identifies some of the ailments which affected our ancestors" (Sournia, 1992:15). Studies in palaeopathology consist of interesting diseases in individual skeletons and mummified remains, consideration of the health of a population, the consideration of specific diseases and of particular themes such as the general living environment and climate, trade, diet and economy, occupation, social status, and access to health care, and their impact on health. The introduction of socio-economic contextual data and statistical analysis in the field has helped to understand the implications that pathological conditions can have in society (Roberts and Cox, 2003).

Palaeopathological evidence comes from primary sources such as ancient human remains (skeletal and mummified) and secondary sources such as artefacts related to surgery and medicine, written records and art (Wells, 1964). However, caution is needed here, as the description or depiction of a pathological condition can only represent the opinion of the artist and authors, which usually focus their descriptions and depictions on the more interesting pathological conditions of the time, therefore, leaving out many diseases that could also have had an impact on the population (Wells, 1964; Roberts and Manchester, 2005). In addition, "different diseases may produce similar signs and symptoms. For example ... the skin rash of chickenpox, leprosy and measles" (Roberts and Manchester, 2005:2).

The history of palaeopathology can be divided in four stages (Aufderheide and Rodríguez-Martín, 1998):

- Stage I- Antecedent: comprises the time from the Renaissance to the mid-nineteenth century. Studies at this stage focused on fossil remains. For example, in the 18th century Johann Esper studied a bear femur and identified that it had osteosarcoma (Esper, 1774; Waldron, 1994a).

- Stage II- Genesis: extends from the mid-nineteenth century to the First World War. In this stage, studies of ancient human remains began. Three important events consolidated the study of these remains: "First of all the migration of settlers to the west coast of America where large quantities of skeletal human remains were found. Secondly, the discovery of fossils hominids in France and Germany and thirdly, the excavation of the cemeteries in Nubia in advance of the construction of the Aswan Dam on the Nile, which produced enormous numbers of skeletons and mummies " Waldron (1994a:1). In 1872 Rudolf Virchow described shortening of an ulna and humerus due to rickets and osteoarthritis in Neanderthal remains (Virchow, 1872) and in America between 1822 and 1839 J.C Warren and S.G Morton worked on the crania of mound builders and discovered that some of them were affected by artificial cranial deformation (Warren, 1822; Morton, 1839; Waldron, 1994a). Early studies were mainly descriptive of individual cases or group of cases and they were mostly based on the crania (Aufderheide and Rodríguez-Martín, 1998). For example, the first PhD in physical anthropology in America was awarded in 1898 (Harvard University) to Frank Russell (1868-1903) and was concerned with Eskimo crania (Spencer, 1982:2).

- Stage III- Consolidation: 1913-1945. In this stage paleopathology became more scientific, microscopic and statistical methods were included in the study of ancient skeletal remains. "The huge volume of human remains which was uncovered by the archaeologists between about 1880 and 1930 stimulated a great deal of activity in paleopathology, associated especially with the names of Marc Ruffer (1913, 1921) studied animal and mummified human remain from Egypt), Elliot-Smith and Wood Jones (1910) in Britain (studied infectious diseases in the Nile (Nubia)), Pales in France (1930) and Hrdlicka (1941) and Moodie (1923a, 1923b) in America" (Waldron, 1994a:2). In 1913 Ruffer is seen as the first person to use the term "palaeopathology" in relation to animal remains (Waldron, 1994a; Roberts and Manchester, 2005). However, Waldron (1994a) notes that the term was probably used long before Ruffer did. Importantly, in 1930 Earnest Hooton's work on Pecos Indians, he looked at disease within a population as opposed to individuals. Using statistical analysis he reported the prevalence of osteoarthritis in this population (Hooton, 1930; Waldron, 1994a; Aufderheide and Rodríguez-Martín, 1998; Beck, 2006). In the same year, the American Association of Physical Anthropology held it first meeting in Virginia (Spencer, 1982). Another important personality in this Consolidation Stage is Aleš Hrdlĭcka, who in 1918, launched the American Journal of Physical Anthropology and in 1941 was the curator of important skeletal samples from North and South America at the Smithsonian Institution (National Museum of Natural History, Washington, D.C). Studies done in these skeletal collections contributed to the establishment of palaeopathology as a scientific discipline (Spencer, 1982; Aufderheide and Rodríguez-Martín, 1998; Rakita, 2006).

- Stage IV- New Palaeopathology: 1946 to today. The new palaeopathology combines information on palaeopathology, epidemiology, demography and biocultural evidence (diet, occupation, social status, climate, etc) to analyse hypothesis and test with skeletal data from large samples (Aufderheide and Rodríguez-Martín, 1998; Roberts and Manchester, 2005:4).The integration of cultural and biological data is essential in bioarchaeology (Ortner, 2006:xiv). Waldron (1982:4) notes that in the late 1950s and early 1960s the consolidation of palaeopathology as an important field in the study of past human populations, was brought thanks to rise of physical anthropology and that the work of Brothwell and Sandison (1967) and the formation of the Palaeopathology Association in 1973 by Aidan Cockburn and others. At this stage, there was a definite move from case studies to population based studies (Wood *et al.*, 1992). Roberts and Manchester (1992: 4) note that in the early 1990s there was an increase in the use of isotopes and biomolecular methods of analysis to identify diseases, primarily the extraction, amplification and analysis of ancient DNA specific to pathogens.

1.2 Palaeopathology in Britain: A Note

The development of palaeopathology in Britain has in some way followed the developments in North America (Roberts and Cox, 2003; Roberts and Manchester, 2005). Initial studies in palaeopathology in Britain focused on individual cases of pathological lesions, however, the biocultural approach mentioned before was adopted in the mid-1980s (Roberts and Cox, 2003; Roberts, 2006). Recently in Britain, the shift between the studies of individual cases and population studies has taken place. Many British universities (e.g. Bradford, University College London, Durham, etc) offer courses in palaeopathology and many students enrol in Masters and PhD programs to research exclusively in palaeopathology (Roberts and Cox, 2003; Roberts, 2006). In addition, since 1999 the British Association of Biological Anthropology and Osteoarchaeology (BABAO) has held annual conferences to discuss recent studies in the World, but most importantly research in Britain.

Roberts and Cox (2003: 23) give a list of important bioarchaeologists in Britain: David Birkett, Don Brothwell, Keith Manchester, Juliet Rogers, Ann Stirland, Tony Waldron, Calvin Wells and Simon Hillson. In addition, Charlotte Roberts, Jackie McKinley and Margaret Cox, to name few, are influential and have helped to further the approach of the New Palaeopathology.

1.3 This study

This study aims to consider data on health during three periods of time in Britain (Romano-British, Early Medieval and Late Medieval) and to explore reasons for the patterns seen in the archaeological and historical records, and focus on the apparent better health in the Early Medieval period identified by other authors. Although this pattern has been identified, few studies have been conducted in depth on this improvement in health during the Early Medieval period and compared it to the Romano-British and Late Medieval periods. In addition, all the sites investigated are located in the southern and eastern region of Britain to facilitate comparison between the sites and provide a more accurate picture of the past as it is possible that similar diet, climate and environment were found during these periods. This regional concentration also differs from other studies which tend to focus on Britain as a whole. These special characteristics (focus on the improvement of health during the Early Medieval period, regional study, and the introduction of other markers of stress) make this research unique and relevant in palaeopathology. It is important to note that this is an overview on health in southern and eastern England in the Early Medieval period.

1.4 Stress Markers Used

To investigate health, a number of 'indicators of stress' (Goodman *et al.*,1988) were considered (life tables and mortality profiles, adult stature, growth curves (indicating retardation and shape differences), sexual dimorphism, Harris lines, vertebral canal stenosis, skull base height, enamel hypoplasia, dental asymmetry and crowding, traumatic lesions, periosteal infection, osteoporosis, porotic hyperostosis and cribra orbitalia). Along with dental caries, conditions related to nutritional deficiencies (i.e. scurvy and rickets) and psychological stress were added to this list. However, following careful scrutiny, stature, dental caries, enamel hypoplasia, cribra orbitalia, tibial periostitis, and age at death profiles were chosen for study. It is known that psychological stress cannot be observed directly in a bone which is a problem in palaeopathology, however, stress markers could represent periods of psychological stress, the relevance that it has in the development of the well-being of a person is noted. Reasons why the stress markers mentioned above were used are the following: not all the skeletal reports document all the variables of Goodman et al (1988), ultimately making the comparison between the reports very difficult. This problem was increased by the fact that Harris lines can disappear as the person gets older, assessment of vertebral canal stenosis and osteoporosis need especial equipment (at a minimum radiography) to be recorded and this is not available to every bioarchaeologist. Additionally, conditions such as porotic hyperostosis, scurvy and rickets are not found very often in Early Medieval Britain (Roberts and Cox, 2003); consequently finding data related to them is problematic. Therefore, only the most commonly recorded skeletal and dental markers of stress were investigated. The relationship between these conditions and their different possible aetiologies (socio-economic, dietary, cultural and environmental) make them the best choices to understand markers of stress and to determine health status for all the periods. Conditions such as tuberculosis, leprosy, syphilis, congenital and neoplastic disease were not studied as they are not classified as markers of stress and also they have specific known aetiologies and causative pathogens.

1.5 Aims of the Study

The aim of this research is to study the health of the Early Medieval population (AD 450 –AD 1066) in southern and eastern Britain and compares the results with the health of the Romano-British (AD 43 – AD 450) and Late Medieval (AD 1066– AD 1600) people. In palaeopathology several studies conducted at a national level (Brothwell, 1961; Wells, 1963; Moore and Corbett, 71, 73, 75; Roberts and Cox, 2003; Roberts and Manchester, 2005) have noted that in Britain during the Early Medieval Period (when compared with the Romano-British and the Late Medieval period) stature increased and dental caries decreased, perhaps demonstrating that people were healthier during this period than in any other period. It is the aim of this research to demonstrate or test if these data provided by previous studies, especially those given by Roberts and Cox (2003) are correct. In other words, were people in the Early Medieval period healthier than their predecessors and their successors? As previously mentioned, the regional focus (south and east England) of this research makes this thesis an innovative study. It is relevant to mention that as the research intended to study at broad trends (several indicators of stress in the south and east of England from the Romano-British to the Late Medieval period), it involved considering data from more than 21 cemeteries and over 6000 individuals; however financial implications of self-funding limited to study skeletal samples of unpublished data, therefore research concentrated only on secondary published and unpublished material. Importantly, consideration of the limitations of studying this kind of data was noted.

Questions to be addressed by the study were the following:

- Would the results on stature and dental caries resemble the outcome of the previous studies?
- Would the results of the other markers of stress support the idea that people during the Early Medieval period were healthier than the people from other periods?
- What are the reasons or factors that influenced the results?
- Is there anything new that can account for the changes?

1.6 Structure of the Thesis

In total there are nine chapters. Following this chapter, Chapter Two on skeletal and dental Markers of "stress" discusses the general background to the conditions considered along with definitions, aetiological factors, and methods of recording. In Chapter Three the cultural contextual background to the Romano-British period is introduced. A description of evidence for general living environment and climate, settlement patterns, trade, diet and economy, occupation, social status, access to health care, religion and burial practices is considered. A regional focused approach is applied;

for example, data is drawn from secondary literature and case studies relevant to the south and east of England. In addition reference to broader literature sources are used to support the cultural contextual background data of the period. The same format applies to Chapter Four (Early Medieval period) and Chapter Five (Late Medieval period). In Chapter Six the materials and methods used in this research are presented. In Chapter Seven the results of the data analysis are presented and described, tables, figures and statistical analysis is used to explain and illustrate the results. In Chapter Eight the data is discussed in relation to cultural contextual data to explain the patterns seen. In addition a section on psychological stress and an alternative hypothesis is introduced, and finally Chapter Nine concludes with a summary of the findings, limitations of the study and future work sections are included. In addition to the chapters the extensive bibliography used during this research will be given along with relevant appendices to support the data. Appendices include: original skeletal reports considered, recording form, list of data collected from each report, data in Microsoft Excel sheets, archaeological sites and list of analytical methods used for each skeletal report.

Chapter 2: Skeletal and Dental Markers of "Stress": Overview

2.1 Introduction

Stress is the sum of the biological reactions to any adverse stimulus, physical, mental, or emotional, internal or external, that tends to disturb the organism's homeostasis; should these compensating reactions be inadequate or inappropriate, they may lead to disorders or diseases, especially when the individual is not prepared for the stress (Bush, 1991; Crews, 2007). Crews (2007:1028) explains that "physiological responses to stress generally accelerate somatic wear-and-tear and chronic degenerative conditions". Selye (1976: xv and 63) notes "No one can live without experiencing some degree of stress all the time...but it all depends on how you take it. The stress of exhilarating, creative, successful work is beneficial, while that of failure, humiliation and infection is detrimental". Today, not only physical and mental illness causes stress. The type of occupation a person practices, the climate and environment in where they live, preparations for a long journey, writing an examination, taking a driving test and even winning a football game can produce a reaction that could affect the normal equilibrium of the body (Goodman *et al.*, 1988; Cohen, *et al.*, 1993; Garrow and James, 1993; Litt *et al.*, 1995; Brothwell and Brothwell, 1998; Bush, 1991; Smith *et al.*, 2000; Crews, 2007). "Stress is not even necessarily bad for you; it is also the spice of life, for any emotion, any activity causes stress...Stress can be avoided only by dying" (Selye, 1976: XV and 63).

Both the nervous system and the endocrine (hormonal) system (especially the pituitary and the adrenal glands) help the body to maintain its homeostasis (Selye, 1976). However all these systems can be influenced by other hormones (such as adrenalin, or those produced by the thyroid gland), the type of diet eaten, exposure to trauma, emotional stress and disease (Brooke-Wavell *et al.*, 2002; Eller *et al.*, 2006). Stress was first documented by indication of adrenal stimulation, shrinking of lymphatic organs, gastrointestinal ulcers and loss of weight in rats which were exposed to forceful immobility, causing frustration and stress (Selye, 1976:24 and 55). Additionally during World War II many people in Great Britain developed digestive diseases (bleeding gastric or duodenal ulcers) almost immediately after an intense bombardment by invading forces. According to Selye (1976:260) "many of the affected persons had not been physically hurt in any way during the attacks but...they suffered the great stress of extreme emotional excitement". Post-traumatic stress disorder and psychosis has also been linked more recently to war veterans (Campbell and Morrison, 2007).

As its name suggests, markers of stress seen in skeletal remains from archaeological sites mark that some kind of stressful stimulus was present in the past to cause changed in some of the structures of the body, such as organs, bones, teeth and even its chemical composition (for example, the elevation of cholesterol and insulin levels) (Bush, 1991; Crews, 2007). However, the causes of stress markers are difficult to assess, mainly because of their multifactorial nature and variety of manifestations in skeletal remains and in their effect on a person but, when assessment is possible, very important information can be obtained (Tuross, 2003: 72). For example, disease, inadequate diet, psychological stress, changes in the environment and climate or even pleasurable stimuli could produce the same stress marker in the skeletal system and this is why they are usually called "non-specific indicators of stress" (Goodman *et al.*, 1988; Bush, 1991; Garrow and James, 1993; Brothwell and Brothwell, 1998).

For example, when looking at one potential cause of stress markers, inadequate diet, Brothwell and Brothwell (1998:176-179) list different reasons why malnutrition may occur: they include inadequate climatic conditions (for example, too cold or very hot to allowed normal development of plants), human disease, plant and animal diseases (e.g., rust, mildew in plants and bovine tuberculosis and sheep pox in animals), agricultural neglect, food destruction or crop failure, and population growth leading to an inadequate supply of food. Lower socioeconomic status also contributes to malnutrition and undernourishment; because people living in poverty among other problems, would not be able to eat a well-balanced healthy diet. In some societies sex differentiation also exists in the access to food; for example males could be allow to eat the best food available, while women might not have had access to good healthy food (Dyer, 2000). As indicated above, changes in the environment and climate can also produce stress; for example the increase in water, environmental and air pollution from chemical agents, rubbish and associated micro-organisms, and even noise can induce physiological and psychological problems for people, particularly if people live in overcrowded and urbanized areas (Selye, 1976:381).

The multifactorial aetiological nature of stress becomes a problem when assessing levels of stress from skeletal remains because it is impossible to identify what specifically caused the changes to appear and several and conflicting conclusions may be reached. The changes recognised in skeletal remains are the result of adaptive responses that an individual had to stressors within their environment (Selye, 1976; Goodman *et al.*, 1988; Bush, 1991; Wapler *et al.*, 2004). In other words, the changes are the body's mechanism of defence against stress. Simply, specific changes recognisable in the skeleton are accepted as an indication of stress (Selye, 1976; Goodman *et al.*, 1988). The function of the response is to maintain homeostasis, or balance the body's physiological or anatomical systems (Bush, 1991). However, it is important to state that if a skeleton does not display any marker of stress, it may indicate that the individual was very healthy; this means that stressors did not produce an adaptive skeletal response or that the individual was unable to respond to the stress and never recovered to display a skeletal stress marker before the person died (Wood *et al.,* 1992; Roberts and Manchester, 1997:164).

The interactions between stressors also need to be taken in consideration when studying them in skeletal remains. Adaptation to one stressor may be favourable to other stressors or detrimental to other stressors (cross-adaptation) (Selye, 1976; Goodman *et al.*, 1988; Bush, 1991; Crews, 2007). Selye (1976:221-222) demonstrated that the same stressor produced different reactions in different laboratory rats. For example, in one case, the initial irritant (an air pouch under the skin) was inhibited and repressed by general stress (frustration and struggle). In another case, the same initial irritant was uninhibited or unrestrained by general stress, consequently damaging, and spreading under, the skin. For example, a change observed in skeletal remains could be an adaptation to many stressors (Goodman *et al.*, 1988). Furthermore, taking into consideration this multistressor factor, it is also important to consider the individuality of response to stress (Crews, 2007). This should be done especially when the health of a skeletal population or community is being studied; each person will be unique in terms of dealing with a particular stressor (as the rats reacted in Selye's laboratory). Therefore, the same stressor may produce different changes in two or more different individuals (Selye, 1976). However, at the same time, there exist similar responses in people with a common cultural and environmental background (Bush, 1991; Crews, 2007).

As previously mentioned, Goodman *et al.* (1988:179) usefully provided a list of skeletal and dental markers of stress: "life tables and mortality profiles, adult stature, growth curves (indicating retardation and shape differences), sexual dimorphism, Harris lines, vertebral canal stenosis, skull base height, enamel hypoplasia, dental asymmetry and crowding, traumatic lesions, periosteal infection, osteoporosis, porotic hyperostosis and cribra orbitalia". Other possible skeletal indicators of stress are the presence of dental caries and any other skeletal changes related to traumatic, inflammation, infectious, and nutritional deficiencies, all of which may also be considered as indicators of skeletal stress when investigating adaptation.

The rest of this chapter is devoted to an overview of the markers of stress considered in this research: dental caries, enamel hypoplasia, stature, cribra orbitalia, tibial periostitis, and age at death. As previously noted reasons why the stress markers mentioned above were used are the following: first of all, not all the skeletal reports consulted document all the variables of Goodman et al (1988), ultimately making the comparison between the reports very difficult. Second the fact that Harris lines can disappear as the person gets older. Third assessment of vertebral canal stenosis and osteoporosis need especial equipment (at a minimum radiography) to be recorded and this is not available to every bioarchaeologist. And fourth, research has shown that conditions such as porotic hyperostosis, scurvy and rickets are not often found in skeletal material from Early Medieval Britain (Roberts and Cox, 2003); consequently making data related to these conditions very difficult to study during this period. Therefore, only the most commonly recorded skeletal and dental markers of stress (dental caries, enamel hypoplasia, stature, cribra orbitalia, tibial periostitis, and age at death) were investigated (see: Pindborg, 1970; Wells and Cayton, 1980; Kennedy, 1984; Burt *et al.*, 1988; Lukacs, 1992; Litt *et al.*, 1995; Hillson, 1996; Lingstrom *et al.*, 2000 for dental caries research. Suckling *et al.*, 1983, 1987; Lukacs, 1989; Goodman and Rose, 1990; Dobney and Goodman, 1991; Brothwell and Brothwell, 1998; Dobney and Ervynck, 1998, 2000 for enamel hypoplasia research. Nickens, 1976; Rimoin *et al.*, 1986; Bogin, 1999; Zakrzewski, 2003; Ortner, 2003; Önenli-Mungan *et al.*,2004; Perola *et al.*, 2007 for stature research. Stuart-Macadam, 1985a; Kent *et al.*, 1994; Schultz, 2001, 2003; Yildirim *et al.*, 2005 for cribra orbitalia research. Goodman *et al.*, 1988; Resnick, 1995; Schultz, 2001; Aufderheide and Rodríguez-Martín, 1998; Vandermergel *et al.*, 2004; Wenaden *et al.*, 2005 for tibial periostitis research and Wood *et al.*, 1992; Molleson and Cox, 1993; Roberts and Manchester, 1997; White, 2000 for age at death research). Most of the skeletal reports chosen had good information on these conditions, therefore facilitating the selection of these markers of stress. The relationship between these conditions and their different possible aetiologies (socio-economic, dietary, cultural and environmental) make them the best choices to understand markers of stress and to determine health status for all the periods.

2.2 Skeletal and Dental Markers of "Stress" Considered

2.2.1 Dental Disease

(i) Introduction

Because teeth are commonly resistant to destruction during burial, they are usually preserved well for long periods of time. For example, the remains of early hominids are often represented by teeth (Hillson, 2002); this is probably the reason why dental disease is one of the most commonly noted pathological conditions in archaeological populations. During a person's life, the mouth is in direct contact with the environment. It is the entrance not only for food and drink but also for bacteria, parasites and toxins, and furthermore the mouth (teeth, jaws, and muscles) provides the means for mastication of foodstuff (Pindborg, 1970; Dobney and Goodman, 1991; Moynihan, 2003). In other words, the morphology of the teeth are often affected, scratched and marked by contact with food (Dobney and Goodman, 1991), "The function of teeth is to process foods" (Lee-Thorp and Sponheimer, 2006: 132). Therefore, through the study of dental disease, information on diet, economy, living environment, social status, dentistry, oral hygiene, lifestyle, occupation and stress may be obtained (Litt *et al.*, 1995; Hillson, 2002). Lukacs (1989) discusses the interaction between oral diseases and their causes, and points out that for dental disease to occur there is always an interaction between several different aetiological factors. For example, Collins and Freeman (2007) have linked general health and psychosocial factors in the homeless in Belfast to poor dental health. A higher incidence of dental caries, periodontal disease and oral cancer was found in people who suffer from psychotic illness, depression and anxiety.

2.2.1.1 Dental Caries

(i) Introduction

Dental caries are one of the most frequent infectious diseases found in ancient populations (Roberts and Manchester, 2005:65). They are the result of the fermentation of food sugars (especially sucrose) by bacteria (*Streptococcus mutans, Lactobacillus acidophilus, Lactobacillus casei,* etc) in plaque on the teeth. The acids (lactic acid) produced by the bacteria (acidogenic bacteria) demineralise and progressively destroy the teeth (enamel, dentine and cement) with carious lesions (Figure 2.1) potentially developing in parts of the crown (enamel) or root (dentine) (Pindborg, 1970; Burt *et al.*, 1988; Litt *et al.*, 1995; Hillson, 1996; Lingstrom *et al.*, 2000). When dental caries are left untreated the infection could travel to other parts of the body via the blood and lymphatic systems leading to pain and swelling (Litt *et al.*, 1995; Hillson, 1996; Lingstrom *et al.*, 2000).

Figure 2.1 Dental Caries on molar teeth from Early Medieval Eccles, Kent (Teaching Collection Photographs, Department of Archaeology, Durham University). Note the affected crown and root.

Dental caries are multifactorial in aetiology; they can be caused by environmental factors such as lack, or excess, of trace elements in food and water (for example, low levels of fluoride), pathogenic agents (the bacteria causing the disease), specific factors such as diet, the poor oral hygiene, genetics predisposition, artificial modification of the teeth and dental treatment (Pindborg, 1970; Burt *et al.*, 1988; Larsen, 1995; Hillson, 1996; Brothwell and Brothwell, 1998; Lingstrom *et al.*, 2000; Hillson, 2002; Moynihan, 2003). Cognitive and psychological factors can also predispose the body to develop dental caries (Litt *et al.*, 1995). For example, people under stress do not worry about their family's oral hygiene and diet; they tend to worry about other issues (Litt *et al.*, 1995). In consequence, their dental and general health is affected. On the other hand, societies with a strong familial and kin-based relationships tends to support each other in all aspects of life, and probably less psychological stress is also found (Light *et al*, 2004; Perlman, 2007), therefore, is it possible that people in these families considered their own and family's oral hygiene and diet; encouraging in this way a good dental health.

Wells and Cayton (1980: 286) indicate that there is a strong relationship between the number of dental caries and the general pattern of diet of a population; for example, hunter-gatherers, who have a meat based diet, would have a lower caries prevalence rates than people that consume cereals, such as wheat, and refined flour and sugars, which have a rapid fermentation rate. In other words, protein in the meat does inhibit the formation of dental caries (Wells and Cayton, 1980; Larsen *et al.*, 1991; Larsen, 2000). As an illustration, a study of Nubian populations found a relationship between a diet of cultivated cereals and a greater frequency of dental caries (Beckett and Lovell, 1994). Kennedy (1984) and Lukacs (1992) also found that dental caries increased in the Indus Valley with the introduction of agriculture and that hunter-gatherers showed a low rate of dental caries. This was also found by Larsen (1995) populations practicing agriculture, showed a higher prevalence of dental caries. In this case, the low protein intake and the high quantity of carbohydrates support the development of dental caries. In contrast, a diet with high protein and fluoride content, For example a marine food based diet, would prevent the development of dental caries (Wells and Cayton, 1980; Larsen *et al.*, 1991; Larsen, 2000).

Sugars are the most cariogenic of the carbohydrates and bacteria in plaque ferments these carbohydrates (Holloway and Moore, 1983; Burt *et al.*, 1988; Winter, 1988; Mays, 1991; Lingstrom *et al.*, 2000; Moynihan, 2002, 2003). This decreases the pH of the mouth (which usually is around 7.0) leading to demineralization of the tooth, especially when the sugar is consumed very often and for long periods of time (Winter, 1988; Lingstrom *et al.*, 2000; Hillson, 2002; Moynihan, 2002, 2003). Hillson (2002:282) noted that the dental caries rate decreased in Japan, Norway and the Island of Jersey during the Second War World (1939-1945) when sugar was rationed and demineralization of the tooth was not possible, but soon after the war, dental caries increased as sugar supply was increased. Additionally, the micro-organisms or bacteria present in the saliva and mouth are determined by the type of food consumed. Therefore, the presence of dental caries may vary, depending on the food consumed and the consistency of it (Winter, 1988; Litt *et al.*, 1995; Lingstrom *et al.*, 2000; Hillson, 2002). Moynihan (2002: 563) recommends that today dental practitioners need to advise people on the negative effects on teeth of sugary foods.

Other possible causes of dental caries are endogenous factors related to the teeth themselves, such as overcrowded teeth, the shape and structure of the teeth. For example, molar crowns are by their nature convoluted, showing fissures, ridges, crests and pits where food particles and plaque can easily get trapped, eventually leading to dental caries. In addition, along with a lack of dental hygiene, elements in the saliva, plus the intricate shape of the molar crown, could encourage the development of dental caries (Powell, 1985; Litt *et al.*, 1995; White, 2000; Hillson, 2002; Moynihan, 2002, 2003). However Burt *et al.* (1988) explains that fissures and pits on the teeth do not necessarily mean that dental caries will be formed, but could predispose people to develop dental caries as long as sugars are consumed.

Despite the use of dental microwear to determined the diet of ancient populations (Lee-Lee-Thorp and Sponheimer, 2006), dental wear is another underlying factor that can predispose to the development of dental caries, and dental wear can result from masticatory stress as a consequence of abrasive material in foods (attrition), erosion from exposure of the teeth to an acidic environment (e.g. acidic foods, drinks and general pollution in the environment), grinding of the teeth, and abrasion (e.g., as a result of cultural activities such as food preparation, use of toothpicks, working leather with the teeth and jaws, smoking, or using tools in direct contact with the tooth surfaces, etc) (Miles, 1963; Lovell and Lai, 1994). As previously noted, the simple everyday activity of processing foods (eating) can also lead to tooth wear which promote the loss of enamel and the exposure of dentine and pulp cavity which can lead to dental caries; some foods contain abrasive material, requiring forceful mastication. When eating specific foods on a regular basis the morphology of the teeth can be affected, generating the production of cavities (Moore and Corbett, 1971; Powell, 1985; Roberts and Manchester, 1997; Hillson, 2002). Abrasive material can also be added to the food during its preparation. Increased amounts of "grit" in the diet of Nubian populations have been identified as the cause of the increased dental attrition found (Beckett and Lovell, 1994). Sand, dust and pieces of stone from querns, or just sand and dust from the general environment, can also get incorporated into the flour, and food produced, possibly also contributing to dental wear (Brothwell and Brothwell, 1998).

Moore and Corbett (1971: 166) suggest a coarse diet for the Anglo-Saxon population in Britain, which could be the cause for the dental wear found in skeletons. On the other hand, Moore and Corbett (1971:151, 1973) and Roberts and Manchester (1997: 53) suggest that attrition could be beneficial to the teeth as it removes pits and fissures on the tooth surfaces and this prevent the accumulation of food particles in these areas, thus preventing dental caries. Today, the removal of pits and fissures on the teeth can be observed more often in older individuals as they retain their teeth longer now than before, in addition the diet of people living in westernised societies is soft and teeth do not wear down until old age (Yip *et al.*, 2006).

Low income and consequent malnutrition can also predispose people to a number of infectious agents and this could be another cause of carious lesions (Dobney and Goodman, 1991; Litt *et al.*, 1995; Moynihan, 2003). An already frail and fragile malnourished individual, lacking important nutrients and vitamins in the body, would not have a strong enough immune response to withstand infectious agents producing dental caries (Litt *et al.*, 1995). Finally, there is the possibility that inherited factors have an effect on the appearance of dental caries, because the same pattern of cavities tend to run within the same family (Hillson, 2002: 282). Moynihan (2002: 566) gives a list of foods and drinks with low potential for dental caries (bread: sandwiches, toast, crumpets and pitta bread, pasta and rice, unsweetened or artificially sweetened yogurt, low-sugar breakfast cereals, fresh fruit, water and sugar-free drinks) and within the possible anti-cariogenic effect foods are: milk, cheese, peanuts, sugar-free chewing gum, fibrous foods, raw vegetables, and unsweetened tea.

Studies have shown that the prevalence of dental caries in Britain's past and present populations appears to increase as the age of an individual increases; as people age, the chances of being affected by any of the aetiological factors increases (Moore and Corbett, 1971, 1973; Brothwell and Brothwell, 1998; Warren *et al.*, 2000; Hillson, 2001); Warren *et al.* (2000) show that the demand for dental care for the older population in America is increasing rapidly. Studies have shown that the prevalence of dental caries decreases from the Romano-British to the Early Medieval period, and increases again during the Late Medieval period (Brothwell, 1959; Brothwell, 1961; Hardwick, 1960; Moore and Corbett, 1971, 1973; 1975; Corbett and Moore, 1976; Roberts and Manchester, 1997; Roberts and Cox, 2003).Reasons for this change in the prevalence of dental caries will be discussed later. The prevalence of dental caries also varies depending on the sex of the individual; for example, studies have shown that through time usually females suffer more caries lesions than males. The reasons suggested have been attributed to: access to cariogenic food (females being in constant contact with food being prepared), and dental development (females mature earlier than males and more likely to develop dental caries), etc (Lukacs, 1992; Larsen, 1995; Warren *et al.*, 2000; Moynihan, 2003).

When studying the frequency of dental caries in Britain in the different types of teeth from the Iron Age, Romano-British, Early Medieval and Late Medieval periods, it is noted, that in general, carious lesions occur more frequently in the molars, followed by the premolars and then the anterior teeth, incisors and canines (Moore and Corbett, 1971, 1973; Hillson, 2002). A common area for the appearance of dental caries is in the fissures of molars and premolars as food particles and plaque easily gets trapped in these fissures (Pindborg, 1970; Hillson, 2002:272). Identifying and diagnosing a carious lesion in a fissure or pit is complex as the cavities are usually hidden deeply within the tooth crown (Hillson, 1996). Dental caries on the roots of teeth are usually related to periodontitis (inflammation of the periodontium) as the roots are exposed and the cementum "shell" is affected. However, carious lesions can also appear at the level of the cemento-enamel junction on the interstitial surfaces (CEJ); Moore and Corbett (1971:161, 1973:148) found that cavities at the level of the cemento-enamel junction were greatest in Britain during the Iron Age, Romano-British, Early and Late Medieval periods compared to modern times.

(ii) Methods

Lukacs (1989) suggests that, when analysing and recording carious lesions, it is important to distinguish between "true" and "false" caries. False caries are those created by post-mortem changes to the tooth, or by opacities that could stain the tooth (Lukacs, 1989; Hillson, 2002). In skeletal remains, there is also the problem of ante-mortem and post-mortem tooth loss, as it is not clear which of the teeth missing were affected by dental caries (Brothwell, 1963; Hillson, 2001, 2002), thus ultimately reducing prevalence rates. Each carious lesion should be classified by its location (e.g. coronal or on the root surface) on the tooth. Coronal cavities can be described as occlusal, buccal/labial, lingual, mesial or distal and cervical (neck). In addition the size of the lesion need to be recorded, for example, cavities can be pits or small fissures, or medium to large (less than one-half of the tooth crown destroyed), or large (more than one-half of the tooth crown destroyed respectively), or complete (destruction of the tooth crown, with only the roots remaining) (Lukacs, 1989; Hillson, 2001). Standardization of the recording system not only of dental caries but any other condition is needed to allowed comparison between populations (Hillson, 2002).

2.2.1.2 Enamel Hypoplasia

(i) Introduction

Enamel hypoplasia can be described as a developmental defect in animals and humans, which can occur during the formation of dental tissues and their supporting structures (the jaw) (Suckling *et al.,* 1983, 1987; Lukacs, 1989; Goodman and Rose, 1990; Dobney and Ervynck, 1998, 2000). They reflect a deficiency in enamel thickness due to a disruption of ameloblast (enamel forming cells) activity (Lukacs, 1989; Goodman and Rose, 1990; Dobney and Goodman, 1991; Hillson, 2002). Ameloblasts produce enamel matrix in successive or incremental layers. After the first layers are produced at the cusp tips, further enamel matrix is secreted appositionally to form dome-like layers (Goodman and Rose, 1990; Hillson, 1996, 2002; Ortner and Turner-Walker, 2003). Ameloblasts have differential secretory rates and life spans which determine the thickness and morphology of enamel, as well as crown morphology

(Goodman and Rose, 1990; Bush, 1991; Hillson, 1996). It is relevant to remember that when enamel hypoplasia is observed in permanent teeth of adults and adolescents, it is a representation of infant-childhood stress that occurred when the tooth was growing (Goodman *et al.,* 1988).

Enamel hypoplasia is observed as lines, pits or grooves on the enamel surface (Figure 2.2), which are more easily observed on the central and lateral incisors and the canines in living people and archaeological teeth (Pindborg, 1970; Suckling *et al.,* 1983; White, 1988; Stroud, 1993; Hillson, 1996; Dobney and Ervynck, 1998). Brothwell and Brothwell (1998:186) also indicate that enamel hypoplasia could deform the tooth crowns to a noticeable degree. It is important to bear in mind that certain teeth (incisors and canines) seem to be more predisposed to enamel defects than others; for example, molars are rarely affected (Goodman and Armelagos, 1985; Hillson, 1996). This is due to several factors, for example, the early development of incisors and canines compared to molars. Also, anterior teeth are more hypoplastic than posterior teeth which make them more susceptible to have ameloblastic disruption (Goodman and Armelagos, 1985; Hillson, 1996). Therefore, frequencies may differ depending on which teeth have been preserved and analysed (Wells and Cayton, 1980; Dobney and Goodman, 1991). Once enamel is secreted and formed it should last the entire life of an individual (Goodman and Rose, 1990; Tuross, 2003). Remodelling away defects is not possible as in bone, so when stress affects the teeth, a defect will be permanently recorded in the enamel (Dobney and Goodman, 1991). However, carious lesions could develop within the hypoplastic defects because of the enamel being weakened by the hypoplasia (Hillson, 2002).

Figure 2.2 Enamel Hypoplasia on mandibular teeth from Early Medieval Raunds, England (Teaching Collection Photographs, Department of Archaeology, Durham University).

There are many reasons for the appearance of enamel hypoplasias. First of all, the appearance of enamel hypoplastic lines in teeth could be because of emotional stress, stress disrupting amelogenesis (Hillson, 1996). Therefore, the presence of defects will provide a record of growth disruptive stresses that occurred during the childhood years (birth to about 13 years) (Lukacs, 1989; Dobney and Goodman, 1991). In addition, nutritional deficiencies, and childhood illness are the major causes for hypoplasias (Pindborg, 1970; Dobney and Goodman, 1991; Stroud, 1993). For example, Dobney and Goodman (1991) and Sweeney *et al.* (1971) reported that an undernourished population has the risk of developing nearly double the number of enamel hypoplasias than a properly nourished population. During growth, teeth need protein, calcium, phosphate, trace elements and vitamins A, C and D (Ortner and Turner-Walker, 2003: 35); without any of these elements a person may become stressed and enamel growth could be affected.

Enamel hypoplasia is also related to the weaning period. Weaning initiates stress strong enough to produce changes in the enamel and disrupt the normal growth process of the teeth. When the weaning period starts and the infant begins to feed on solid foods, many nutrients and vitamins may be inadequate and insufficient for the child (Hood *et al.*, 1978). For example, many of the antibodies that breast-feeding provides are not available to the infant, leaving poor resistance to infectious agents and other environmental stress; as a consequence the child's weight and health may decline, and even death may occur (Hood *et al.*, 1978; Lukacs, 1989; Saunders and Hoppa, 1993; Brothwell and Brothwell, 1998; Hillson, 2002; Fuller *et al.*, 2006a). The new diet introduced to the child may also contain pathogens which the child may have not been exposed to (Saunders and Hoppa, 1993). Brothwell and Brothwell (1998:187) give a modern example of weight loss during the weaning period in children from a village in Uganda. Children's weights were compared to the weights of English children during the weaning period; the results show that the weight of the African children decreased during this critical period (weaning) while the weight of the English children increased at a constant rate through the years (Brothwell and Brothwell, 1998). This study may have relevance to past populations because of the Ugandan population deriving from a traditional way of life. The stress produced by the weight loss during the weaning period can be associated to the development of enamel hypoplasia because interruption of ameloblastic activity can occur. It is also relevant to remember that lactating women can reduce, if not stop completely, the production of milk during intense stress (Selye, 1976), thereby indirectly affecting the nutrition of the infant. It is possible that the secretion of milk is affected by the malfunctioning of the hormones of the pituitary gland (Selye, 1976). Today, through analysis of fingernail and hair, detection of the time of breastfeeding and weaning can be accomplished by the use of carbon and nitrogen stable isotope ratios (Fuller *et al.*, 2006b:279). Interestingly, values of carbon and nitrogen increased when a child is breastfeeding and it decreases when weaning starts and new foods are introduced (Fuller *et al.*, 2006b). Clayton *et al* (2006) applied this finding to an archaeological population (Matjes River Rock Shelter in South Africa) and similar results were achieved. For example, juvenile bone collagen nitrogen declined after weaning. Measurements were obtained from bone collagen and dentine. The same was done by Fuller *et al* (2006a:47) at the Romano-British site of Queenford Farm, Oxfordshire, however this paper give advise that these methods to age weaning and to determine the end of breastfeeding only give a "general time frame for the duration of breastfeeding, a precise calculation of the introduction of weaning foods is not possible, as uncertainty exists about the amount of time needed for the infant skeleton to fully incorporate the isotopically depleted post-weaning collagen".

Enamel hypoplasia is also associated with specific health problems such as vitamin A and D deficiency, hypoparathyroidism, parasitism, exanthematous or eruptive fevers, rickets, scurvy, measles, smallpox, diabetes, cystic fibrosis and syphilis (Suckling *et al.*, 1983, 1987; Lukacs, 1989; Arquitt *et al.*, 2002; Hillson, 2002). All are diseases or conditions that in one way or another can disrupt enamel formation, especially during infancy (Hillson, 2002). However, because enamel hypoplasia is multifactorial in aetiology, it is impossible to identify a specific cause of a particular hypoplastic defect, especially in archaeological populations (Suckling *et al.*, 1987; Dobney and Goodman, 1991). Suckling *et al* (1987: 1466) explain that today "one of the factors contributing to the difficulty in establishing the etiology of the common types of enamel defects is the frequent lack of accurate medical and dental histories. Few parents can remember the date, duration, and severity of all illnesses experienced in their children's first five years of life". Childhood illnesses associated with enamel defects are chicken pox, mumps, measles, and whooping cough (Suckling *et al.*, 1987).

(ii) Methods

The macroscopic method of identifying, examining and recording hypoplasias in the enamel humans is very simple but tooth preservation must be good. It is best undertaken by using an X10 hand lens or loupe with a good light source and a dental probe; running a fingernail over the teeth is also useful to detect the defects. The scoring system for classifying developmental enamel defects in living populations was developed by the Fédération Dentaire Internationale (FDI) in 1977 (Hillson, 1996) and modified for skeletal samples by Buikstra and Ubelaker (1994). According to the system, recording enamel hypoplasia need first to take into consideration the tooth affected, secondly, the position of the defect on the crown (1= cusp, 2= middle section of crown, 3= neck), and thirdly, the type of hypoplasia (linear horizontal grooves, linear vertical grooves, linear horizontal pits, non-linear pits, single pits) (Goodman and Rose, 1990; Dobney and Goodman, 1991; Buikstra and Ubelaker, 1994). Different methods have been designed to record enamel hypoplasia in animals (for example, pigs) (Dobney and Ervynck, 1998).

When enamel hypoplasias are of the linear type, the height of the defect above the cemento-enamel junction can be measured to calculate the age of the formation of the defect (Hillson, 1996; Dobney and Ervynck, 1998; Reid and Dean, 2000). This is possible because tooth crown growth rates are known. However, this can only be done on the assumption that the rate of enamel formation in the past was the same as the present (Lukacs, 1989). For example, today the crowns of canines are formed between the ages of 6 and 7 and the crowns of the incisors are formed between the ages of four and five (White, 1988). Hillson (1996, 2002) cautions the use of this standard method to calculate the age at insult ("stress") because it assumes that enamel growth is linear, but it can vary between individuals, and of course through time. Additionally, the variations in the morphology of teeth are not considered. For example, one side of the tooth could be higher than the other, or a tooth could have an unusual variation (e.g. peg-shaped incisors). Furthermore, multiple hypoplasias in a single individual, for example, could yield clues about the timing and periodicity of repetitive stresses (Lukacs, 1989; Reid and Dean, 2000).

A problem when studying enamel hypoplasia is the variation in methods of classification of the different types of enamel defects used by different researchers (Wells, 1980; Dobney and Goodman, 1991). What one scholar labels as one type of enamel hypoplasia may be categorized as another type by a different researcher. An additional problem is that some studies are based on the deciduous dentition, while others are based on the permanent dentition. This could be a problem if a comparison of data is being undertaken. In addition, attrition to the enamel can erase the lines of enamel hypoplasia. For example, mastication, trauma, or using the teeth as tools, will erode the enamel surface, which can obliterate the lines (Hillson, 1992a, 1992b; Ortner and Turner-Walker, 2003). Furthermore, it is important to remember that hypoplasias representing the same stress point in time will be shown at different locations across the dentition, depending on the sequence of tooth crown formation and its morphology (Hillson, 2002). Also, Dobney and Ervynck (1998: 269) mention that "observations made with the naked eye may result in some lines being overlooked". To counteract this problem the used of a magnifying lens or a low power stereo-microscope is recommended (Dobney and Ervynck, 1998).

Hillson (2002:217) suggests that using a histological method to estimate age at insult of a hypoplastic defect is better than the macroscopic method. This method appreciates that enamel can grow in a non-linear way and can vary. It is also possible to assess microscopic hypoplasias, therefore allowing the study of all possible insults. Finally, the histological method takes into consideration natural morphological variation as well as population differences. On the negative side, this method requires training and the right equipment (microscope), and it is destructive to the tooth. In addition, microstructural clarity is not always uniform across the enamel exterior and varies between individuals. This creates observational difficulties. It is a complex and challenging method, and it is not clearly understood what the size and position of the defects microscopically means (Hillson, 2002).

2.2.2 Stature

(i) Introduction

The final attained stature (height) reached during a person's life is accepted as a good indicator of the person's general health and stress experienced during growth (Nickens, 1976; Goodman *et al.*, 1988; Akachi and Canning, 2007). Increased stature is usually associated with good health and longer life (Kemkes-Grottenthaler, 2005; Akachi and Canning, 2007). Factor such as good nutrition and health during infancy and adolescence are associated with an average and normal height (Akachi and Canning, 2007). If an individual has short stature for his or her genetic background in a population that is characterized by taller individuals, it is possible that this particular individual suffered stress during growth (e.g. inadequate nutrition, emotional distress and poor health) that consequently affected his or her growth rate (Rimoin *et al.*, 1986; Zakrzewski, 2003; Akachi and Canning, 2007). Selye (1976:332) suggests that "if children are exposed to too much (stress), their bodily growth is stunted..."Attained stature can also be affected by the nutritional status and genetic make-up of a person (Nickens, 1976; Rimoin *et al.*, 1986; Bogin, 1999; Kemkes-Grottenthaler, 2005; Perola *et al.*, 2007). In addition, detrimental environmental factors and the presence of a disease can influence final stature. To put it another way, human growth is an outcome of the complex interaction between genes and the environment (Nickens, 1976; Rimoin *et al.*, 1986; Bogin, 1999; Zakrzewski, 2003; Ortner, 2003; Perola *et al.*, 2007). Perola *et al.* (2007:1023) have demonstrated that both factors are relevant in determining stature, for example twins show that similar stature is attributed to genes, but, the initially larger twin at birth tends to remain taller even into adulthood which, according to Perola *et al.* (2007), must be determined by specific environmental factors. Steckel (1995) indicates that, when studying stature, environment is more important than genetics. However, it is important to bear in mind that assessment of individual genetic and environmental effects on attained stature are difficult, if not impossible, to establish in bioarchaeology (Hanson, 1992; Zakrzewski, 2003; Ortner, 2003). In fact, there is a conflict in distinguishing nutritional impact from genetic and environmental influences when studying stature. All these factors are interrelated to determine the final height reached by an individual during his/her life (Frisancho and Baker, 1970; Hanson, 1992; Ruff, 1994; Baten, 2002; Ortner, 2003).

An example of disease affecting stature can be seen, for example, when an individual with an endocrine disease, such as hyperpituitarism, produces too much growth hormone, therefore leading to the problem of gigantism or acromegaly (Selye, 1976; Rimoin *et al.*, 1986). Growth hormone neurosecretory dysfunction and severe depression have also been linked to short stature. Selye (1976:255) noted that the growth of animals stops if intense stress is present, and Önenli-Mungan *et al* (2004) gives a modern example of a nine years old girl with severe depression which eventually affected her stature. Clinical depression and emotional disturbances affect neurotransmitter activities, which in due course impair the secretion of growth hormones, therefore affecting growth (Rimoin *et al.*, 1986). Another example of a disease affecting growth is rickets, where the bones of the legs are affected; ultimately they become bowed, subsequently producing short stature as a consequence of the disease (Roberts and Manchester, 1997:181). However, it is not possible to determine maximum length of bones from skeletal remains affected by rickets, as the measurements are inaccurate because the bones are bowed. White (1988:37) gives an example of one individual from the cemetery of St. Nicholas Shambles with a congenital disorder (diaphyseal aclasia) where stature was also affected, and led to a small individual. In other words, stature and body proportions are influenced by natural, extrinsic and intrinsic factors or a combination of all (Frisancho and Baker, 1970).

Natural factors that can affect stature are climate and altitude (Frisancho and Baker, 1970; Ruff, 1994; Baten, 2002). The relationship is very strong between climate and body size and shape in animals and humans. People living in equatorial or warm regions have a tendency to have linear body proportions with longer limbs and narrower trunks (for example, the Massai from Tanzania and Kenya); this body build maximises heat loss. On the contrary, people that live in polar or cold areas are in general of a stocky build, with a broad or larger trunk, shorter limbs, and are shorter in stature (for example, the Inuit from the Artic areas) (Frisancho and Baker, 1970; Ruff, 1994; Baten, 2002). In other words, they have less surface area, therefore preventing heat loss (Bergmann's and Allen's rules) (Allen, 1877; Ruff, 1994). However, Nelson and Jurmain (1988) caution on the use of these rules to predict body size and shape. For example, acclimatization (physiological plasticity) can play an important role in the final body size and shape attained. "An individual's body size may reflect much more about short-term physiological adjustment to ecological and dietary conditions than about long-term biological adaptation" Nelson and Jurmain (1988:161). Colder weather may stimulate extensive physical activity and appetite. Therefore, an individual living in a cold environment could have longer limbs and narrower trunks (Nelson and Jurmain, 1988; Ruff, 1994; Jurmain *et al.*, 2008).

Another extrinsic factor that affects stature is socio-economic status. Families of low socio-economic status often suffer from malnutrition or undernutrition (Rimoin *et al.*, 1986; Litt *et al.*, 1995; Peña *et al.*, 2003; Budnik and Liczbinska, 2006; Akachi and Canning, 2007).They may have no access to adequate health care, and they may be living in crowded conditions where disease spreads easily. Chronic infectious diseases are common in these settings and living conditions as they are easily transmitted between people, especially children; stopping or not allowing the right amount of calories, vitamins and proteins (balanced diet) needed to achieve a healthy final adult stature. Such people are also prevented from reaching their full genetic potential, so they will not develop and grow normally (Selye, 1976; Bogin, 1988; Ulijaszek, 1990, 1998; Saunders and Hoppa, 1993; Zakrzewski, 2003, Ortner, 2003). On the other hand, families with higher incomes can provide better resources for child development, which in time will be reflected in the good health and higher stature that they have (Budnik and Liczbinska, 2006; Akachi and Canning, 2007). Peña *et al* (2003) studied growth of modern urban and rural children in Oaxaca, Mexico; children from urban areas were taller and heavier than rural children. The urban setting provides better health and sanitation facilities than the rural areas (Peña *et al.*, 2003). However, Budnik and Liczbinska (2006) showed that cities or urban centres in Poland for example have lower life expectancies than rural areas. Causes of death in these areas were attributed to tuberculosis, other respiratory diseases, cardiovascular diseases, cancer, dysentery and diarrhoea. Factors such as industrialisation (with poor facilities and poor ventilation, long working hours, poor hygiene and poverty), high population density and difficult housing situations (one room shared by 5-12 people) influenced this result (Budnik and Liczbinska, 2006:298). Akachi and Canning (2007:399) explain that "differences in height among the well-off social classes across populations tend to be small compared to differences in height across individual within a population". Other pathological conditions and symptoms that have been associated with crowded conditions are adrenal enlargement, decreased fertility and formation of peptic ulcers (Selye, 1976; Akachi and Canning, 2007).

It is important to bear in mind that it is possible for "catch-up" growth to occur after a period of short normal stature or stress (Roche and Sun, 2003; Akachi and Canning, 2007). Eventually, if diet returns to being adequate it is possible to attain the correct stature in relation to a particular age. The nine year old girl studied by Önenli-Mungan *et al* (2004) was able to recover her ideal height when supplies of growth hormones were given. On the other hand, there may not be the capacity to catch up growth when a person enters a later period of his or her life (Roche and Sun, 2003; Zakrzewski, 2003). In later life individuals have reached their maximum maturation, growth and have achieved their final stature; it is impossible then for the body to increase in stature.

Today, a normal person usually reaches their maximum height by around 21 years of age when all the long bone epiphyses are fused, and some shrinkage occurs when the person is older (Akachi and Canning, 2007). Females reach their final height earlier than men due to the fact that female maturity and puberty ("the pubertal growth spurt") occurs before male puberty (Rimoin *et al.*, 1986:711). Females also show a severe height loss after 40 years of age (Bogin, 1999; Kemkes-Grottenthaler, 2005). This reduction in height is related to several factors: loss of bone mass, especially in the vertebral column, shrinkage and compression of intervertebral disks, imbalance of muscle groups, osteoporosis, postural changes and aggravated curvature of the spine (Kemkes-Grottenthaler, 2005: 345). In reality, however, with the accessibility and availability of early vitamin supplements, improvement in health care and prevention of childhood disease, final stature is being reached earlier in life now, and at the same time average stature has increased slightly (Önenli-Mungan *et al*, 2004; Akachi and Canning, 2007). During the past 100 years the general body size of humans has seen a constant increase (Hanson, 1992; Roberts and Cox, 2003; Maat, 2005). For example, Hanson (1992) gives the example of Norwegian males increasing by 3 cm between the medieval period and the twentieth century and Maat (2005: 276) mention that "the average length of Dutch males has increased dramatically over a period of ca. 130 years. The increased has tallied up to 17 cm…". Some studies (Wells, 1963; Roberts and Cox, 2003; Roberts and Manchester, 2005) have shown that in Britain stature increased remarkably during the Early Medieval period (450AD-1066AD) when compared to the Romano-British (43AD- 450AD) and Late Medieval periods (1066AD- 1600AD). The possible reasons for this increased stature will be discussed later. Interestingly, the last health survey for England (2004) gives the mean height of males in England as 1.75m (0.18 S.D) and for females as 1.61m (0.14 S.D) (Department of Health, 2005).

The final stature achieved by an individual is the result of the combination of the length of the lower limbs and trunk and the height of the cranium (Malina *et al.*, 2004). Final growth in long bone length is achieved in the following order: the tibia, the femur, the fibula, and after that the bones of the upper extremity (humeri, ulnae and radius) (Malina *et al.*, 2004; Kemkes-Grottenthaler, 2005). Therefore, any stressful event could affect the maturation of different parts of the skeleton at different times (Rimoin *et al.*, 1986; Zakrzewski, 2003; Kemkes-Grottenthaler, 2005). However, the stature that is observed in an adult is a reflection of childhood health and nutrition during the growing years. As an illustration, growth stunting occurring during the childhood period affecting the limbs will be reflected in adult stature (Rimoin *et al.*, 1986; Zakrzewski, 2003).

(ii) Methods

The method most commonly used to calculate stature by bioarchaeologists is that of Trotter and Gleser (1952, 1958, and 1977) and Trotter's (1970) regression equations and tables (Table 2.1), because they best represent both male and female white populations. The method is based on modern American white and Afro-American populations of known stature at the time of death (American soldiers during World War II (Trotter and Gleser, 1952) and the Korean War (Trotter and Gleser, 1958). Using complete long bones, the maximum length is measured, preferably using the combination of the femur and the tibia (because they best reflect stature) and stature is calculated according to the tables provided by Trotter and Gleser (1952, 1958) and Trotter (1970). It is significant to note that Formicola (1993: 351) considers that Trotter and Gleser's formulae for stature estimation generally tend to overestimate stature for both male and females individuals. Therefore, caution is needed. The use of the lengths of bones only to represent body size is recommended, putting the measurements into an equation introduces errors.

White Males			
1.30	(Fem + Tib)	+ 63.29	± 2.99
2.38	Fem.	+ 61.41	± 3.27
2.68	Fib.	+ 71.78	± 3.29
2.52	Tib.	+ 78.62	± 3.37
3.08	Hum.	+ 70.45	± 4.05
3.78	Rad.	+ 79.01	± 4.32
3.70	Ulna	+ 74.05	± 4.32
White Females			
1.39	(Fem + Tib)	+ 53.20	± 3.55
2.93	Fib.	+ 59.61	± 3.57
2.90	Tib.	+ 61.53	± 3.66
2.47	Fem.	+ 54.10	± 3.72
4.74	Rad.	+ 54.93	± 4.24
4.27	Ulna	+ 57.76	± 4.30
3.36	Hum.	+ 57.97	± 4.45

Table 2.1 Stature regression equations (modified from Trotter, 1970).

There are problems with stature estimation for ancient populations. First, the data used to estimate stature in past people is based on modern data; this assumes that the relationship between bone length and stature was the same in the past compared to today. Bush (1991) also discusses the problem of using stature data from modern populations who have different lifestyles, diet, and health care etc, compared to any past population. The second problem of stature estimation is that sex and ethnicity need to be known because attained stature varies between the sexes and ethnic groups. Therefore, the correct stature regression equation needs to be used. There are several stature estimation formulae available depending on the country or area under study (see Trotter and Gleser, 1952, 1958 (for American black and white populations); Terezawa and Akabane, 1990 (for Mongoloid (Japanese) populations); Mendes-Correa, 1932 for examples of Portuguese white population). The stature estimation formula usually used in Britain is that of Trotter and Gleser as it may represent the European descent that white Americans possess. However, it is relevant to bear in mind that even within the same population and ethnic group, there could be differences in stature as each individual possesses their own genetic makeup. A third problem is that there could be a difference in length between the left and the right side of the body, which would give incorrect data for the calculation of stature. For this reason the bones from the left side of the body are usually used to determine stature. The final stature estimated for an individual could differ depending on the bone used to calculate stature, even if the bones belong to the same individual, if possible the femur and tibia are the best to used (Waldron, 1998). Finally, ancient human remains tend to be fragmentary, therefore preventing the estimation of stature (Wood *et al.,* 1992; Waldron, 1994a; Roberts and Manchester, 1997; White, 2000). It is relevant to remember that, although in the forensic anthropology literature there are equations to calculate stature from fragmentary bones (e.g., Steele, 1970; Simmons *et al.*, 1990), it is recommended that for the calculation of stature for ancient populations, healthy, complete and intact bones should be used.

2.2.3 Metabolic Disease

(i) Introduction

A metabolic disease is caused by a disorder or interruption in the normal processes of cell metabolism. It is a defect of deficiency or excess of dietary elements and hormones (Aufderheide and Rodríguez-Martín, 1998). Hormones are chemicals produced by the endocrine glands of the body for the maintenance of health (Selye, 1976). Disorders associated with metabolic disease are: Chronic kidney disease (secondary hyperparathyroidism: elevated serum parathyroid hormone levels, and alteration of calcium and phosphorus balance) which affects cardiovascular health (Kestenbaum and Belozeroff, 2007). Epilepsy and some of the medication associated with it have been related to obesity and metabolic disorders which again have effects on cardiovascular health (Young and Woon, 2007). Today, obesity is increasing around the world and its contribution to the onset of metabolic disease, diabetes and cardiovascular problems is also increasing. Misra and Vikram (2007:123) describe that "obese children and adolescents reported to have abnormal glucose homoeostasis, fasting hyperinsulanemia, impaired fasting glucose, impaired glucose tolerance, dyslipidemia, and hypertension". But it is important to remember that body fat distribution and the prevalence of metabolic disorders varies with ethnicity (for example, higher prevalence of metabolic syndrome was found in obese non-white teens: black and Hispanic and insulin resistance predisposition is higher in obese Asian Indian children (Misra and Vikram, 2007:122), reason for this difference is given to the fact that Asian Indian children have higher subcutaneous fat in the abdominal area as compared to Caucasians and blacks; adiposity is linked to high insulin concentrations (Misra and Vikram, 2007). A similar link between obesity and metabolic disorders is also reported by Isomaa (2003).

Nutrition or the lack of it is also related to the onset of metabolic disease, to understand the causes of metabolic disease in the past due to dietary deficiency, there are two approaches: stable isotope analysis and assessment of the impact of dietary deficiencies on the skeleton (in addition to enamel hypoplasia). As previously noted, stable isotope analysis and elemental ratios of bones and teeth (enamel) can be done to determine the diet of past populations (Larsen, 2000; Lee-Thorp and Sponheimer, 2006). As Thorp and Sponheimer, (2006: 135) describe "the chemical composition of mammal's tissues, including bones and teeth, reflects that of its diet".

Analysis of elements such as carbon, oxygen, hydrogen, nitrogen, strontium, sulphur and lead in ancient bone (collagen and mineral), teeth, hair and enamel had provided ideas about diet in the past (Katzenberg, 2000; Ambrose *et al.*, 2003; Harrison and Katzenberg, 2003; Richard *et al.*, 2003). The technique uses the natural distribution of the stable isotopes in nature, and it consists of detecting the levels of stable isotopes in any of the human tissues mentioned before. For example, the carbon in bone mineral comes from dissolved bicarbonate in the blood which originates from diet, and carbon in collagen comes from ingested and synthesized amino acids from animal and plant protein (Harrison and Katzenberg, 2003). The two stable isotopes of carbon are ^{12}C and ^{13}C and plants, classified as either C_4 or C_3 on the basis of their mechanism of photosynthesis, differ in isotopic composition.C_4 plants are grasses from subtropical climates with long growing seasons and receive plenty of sunlight; they also absorb more ^{13}C than C_3 plants. Examples of this plant are maize, millet, and sugarcane. On the other hand, C_3 plants dominate in temperate areas and absorb less ^{13}C than C_4 plants. Examples of this type of plant are rice, potatoes, rye, wheat, barley, yams, most vegetables and fruits. Furthermore, marine plants have ^{13}C contents between C_4 or C_3 plants and marine fish and mammals have ^{13}C values less negative than animals feeding on C_3 based foods and more negative values than animals feeding on C_4 foods (Katzenberg, 2000; Privat *et al.*, 2002; Harrison and Katzenberg, 2003; Roberts and Manchester, 2005). In addition, nitrogen isotopes (^{14}N and ^{15}N) are used to differentiate marine and land diets. ^{15}N levels for land plants are lower than the marine plants.

An interesting paleodiet study using stable carbon isotopes from bone apatite and collagen was conducted by Harrison and Katzenberg (2003). The results show that the population of Southern Ontario consumed both, C_4 (e.g. maize), and C_3 plants, and also C_3 –consuming animals (deer and beaver). The population of San Nicolas Island, California consumed marine foods (e.g. salmon) and land C_3 foods (Harrison and Katzenberg, 2003). Also Ambrose *et al* (2003) used stable isotope analysis to identify the diet consumed by high and low status individuals and males and females in a skeletal collection from Cahokia mound in the US. Nitrogen isotope levels demonstrated that high status individuals consumed more animal protein than the lower status individuals, and carbon isotope levels suggests that females consumed more maize than high status individuals (Ambrose *et al.*, 2003). Privat *et al* (2002) studied human and faunal remains from the Anglo-Saxon Cemetery at Berinsfield, Oxfordshire, stable carbon and nitrogen isotope analysis was conducted to determine diet in this population. The isotopic data demonstrated that individuals at this Early Medieval site had a diet based on C_3 foods, and freshwater resources (fish and water birds) and no marine foods. Analysis also indicated that diet varied between social classes, for example, upper classes consumed more herbivore meat and dairy foods from domesticated cattle, sheep and goats that the poorer classes which consumed more aquatic food and omnivore protein (pig) (Privat *et al.*, 2002).

In addition a study by Richards *et al* (1998) used stable isotope analysis to investigate variation on diet at Poundbury Camp Cemetery, Dorchester, England. Skeletal samples included Iron Age, Roman and Post-Roman individuals. Results showed that there was little variation in the isotope values of the Iron Age/Early Roman individuals which indicates a terrestrial based diet of both animal and plant protein (Richards *et al.*,1998:1249). Interestingly, during the Late Roman period, there was variation in the isotope values of individuals in higher status burials (lead and mausolea), which suggests that these individuals consumed marine food, which was different to individuals buried in wooden coffins which did not consume marine foods (Richards *et al.*,1998). More recently, Müldner and Richards (2005) reconstructed diet in Late Medieval England using stable isotope analysis. Skeletal samples from three Late Medieval sites (St. Giles Hospital, the Augustinian Friary and the Battle of Towton) were studied. Interestingly, little variation in diet between the sites was found, however, great amounts of marine foods were consumed, that according to Müldner and Richards (2005: 45-46) supports the impact of religious dietary rules on the population who prohibited the consumption of meat during fasting. Finally it is important to note that stable isotope analysis also can provide evidence on the movement of people in ancient times (Richard *et al.*, 2003; Budd *et al.*, 2004; Knudson and Buikstra, 2007). As well as help in detecting breastfeeding and weaning episodes in modern and ancient populations (see above) (Fuller *et al.*, 2006a, 2006b).

Indirect evidence for food consumed may also be determined by chemical analysis of food residues (plant and animal) found in archaeological sites (Craig and Collins, 2002; Barnard *et al.*, 2007). The diet may also be inferred through food preserved in the gastrointestinal tract of preserved bodies, and also remains of pots, on floors of buildings, in refuse pits, in middens and in coprolite residues (preserved faeces) (Holden and Nú³ez, 1993; Brothwell and Brothwell, 1998; Craig and Collins, 2002; Barnard *et al.*, 2007). As an example, Jones (1991:25) describes bran and chaff in Romano-British coprolite remains at the Antonine fort at Bearsden, near Glasgow. However, it is important to remember that food remains are usually scarce and limited in numbers as preservation of them needs specific conditions (Brothwell and Brothwell, 1998). Animal bone assemblages and distributions can also be used to obtain paleodiet information; however limitations arise when the bone material has accumulated over hundreds to thousands of years (Lee-Thorp and Sponheimer, 2006: 131).

Brothwell and Brothwell (1998:18) suggest that indirect information on ancient diet can also be obtained through the study of artistic representations of animals, plants and foodstuffs. These drawings, paintings and sculptures can be found in caves, rock shelters, tombs, monuments and pottery. However, it must be noted, that these artistic representations may only represent a ritualistic aspect of a society and not their diet necessarily. Caution is needed when using art to study diet from the past as many factors can influence its interpretation (Manchester, 1987; Brothwell and Brothwell, 1998; Müldner and Richards, 2005). Reference to the study of the dietary habits of living traditional populations is also helpful which, by inference and comparison, could help in the study and interpretation of ancient diet. The use of written records can also give a picture of the diet consumed by an ancient society (Brothwell and Brothwell, 1998). As the periods studied in this research fall within the historic period, written records on diet, health, disease and treatment are extensive. For example, during the second half of the tenth century the *Bald's Leechbook* (a medical book of remedies for the treatment of health afflictions) and the *Lacnunga* (an herbal recipes book based on charms and magic) was used to help the treatment of diseases (Cule, 1972; Cameron, 1993; Jolly, 1996; Hall, 2007). Other medical manuscripts included: the Anglo-Saxon Herbal (*Herbarium Apuleius*), the *Medicina de Quadrupedibus*, the *Peri Didaxaeon*, and the *Handbook of Byrhtferth* (Jolly, 1996; Hall, 2007). However, caution is also recommended here as many of these records can be interpreted in different ways and could only represent the opinion of the person who produced the document. It is also important not to generalise about the dietary background of an ancient society when studying the information gain through the observation of the stomach contents of preserved bodies as it can only reveal details of the last meal consumed by one particular individual, and this is not representative of the population as a whole. Also social status, cause and season of death have a strong bearing in the interpretation of food residues (Holden and Nú³ez, 1993:608; Brothwell and Brothwell, 1998).

2.2.3.1 Anaemia

(i) Introduction

Anaemia is the reduction in concentration of haemoglobin (Hb) and/or red blood cells. Normal measurements are for men 13.5g/100 mls and for women 12.0g/100 mls

(Monson, 1988; Stuart-Macadam, 1991; Kent *et al.*, 1994; Wapler *et al.*, 2004). There are several anaemias of different aetiologies (Yildirim *et al.*, 2005). The most common is the anaemia cause by iron deficiency (Tapiero *et al.*, 2001; Yildirim *et al.*, 2005). In the human body, iron is needed for the transfer and transport of oxygen to body tissues and cells, the synthesis of collagen, the conduction of nerve impulses and the regulation of the immune system (Kent *et al.*, 1994; Tapiero *et al.*, 2001). In other words, iron is essential for the development of haemoglobin in newly created red blood cells in bone marrow (Tapiero *et al.*, 2001; Yildirim *et al.*, 2005). In anaemia the red blood cells are pale, very small and have a short existence (60-90 days). The normal lifetime of a red blood cell is 120 days (Cohen, 1982).

Anaemia can be caused by a deficiency of iron in the diet (e.g. lack of meat and fresh green vegetables), but many other factors can influence the appearance of anaemia in an individual. Excessive blood loss or haemorrhage (the main reason for the diagnosis of anaemia today (Tapiero *et al.*, 2001; Wapler *et al.*, 2004) through injury, disease (e.g., infection, vitamin C deficiency, cancer or gastrointestinal problems etc), pregnancy, childbirth, lactation and menstruation can all lead to anaemia. Inadequate absorption of iron (due to diarrhoea), low birth weight (lack of iron stores), and a high consumption of cultivated cereal crops, which contain phytates that can inhibit the absorption of iron, can also contribute to anaemia development. Parasite infestation, especially of the intestines, is another factor in the development of iron-deficiency anaemia because gut infections also affect iron metabolism by either direct blood loss or by causing diarrhoea (Monson, 1988; Kent *et al.*, 1994; Tapiero *et al.*, 2001), thus preventing absorption of iron (Monson, 1988). The infection generally occurs when water or foods infected with parasite eggs are digested, and also when contaminated hands are in contact with the mouth (Stuart-Macadam, 1991, 1992). Evidence of parasitic infestation in archaeological populations can be obtained by studying coprolites and latrine deposits; the parasite eggs are resistant to decay (Brothwell and Brothwell, 1998). Furthermore, in infectious disease, pathogens need iron to survive and reproduce in the body, thus the body withholds iron, making it iron deficient. As a consequence, iron levels may be low due to infection (Stuart-Macadam, 1991, 1992; Kent *et al.*, 1994; Larsen, 2000; Tapiero *et al.*, 2001).

Iron deficiency anaemia can affect anybody, but juveniles are more vulnerable because their body is developing and is not strong enough to prevent infectious disease in the body. Today, iron deficiency anaemia is frequently found in children between the ages of six months to two years old (Tapiero *et al.*, 2001; Yildirim *et al.*, 2005). Roberts and Manchester (1997) indicate that the presence of cribra orbitalia and porotic hyperostosis in an adult skeleton suggests childhood anaemia. However, the condition can continue throughout the person's life (Wapler *et al.*, 2004).

Today, anaemia can be evaluated by using magnetic resonance imaging (MRI). This is a fast and non-invasive method which distinguishes between red and yellow bone marrow and in patients with iron deficiency anaemia and other types of anaemia the thickened and hypointense (low intensity) cranial bone marrow can be detected (Yildirim *et al.*, 2005). Iron deficiency anaemia is recognised in the skeleton by orbital lesions alone, and both orbital and cranial vault lesions together, and the lesions are attributed to individual adaptation to the causal agent (Stuart-Macadam, 1991; Wapler *et al.*, 2004). The vault lesions are known as porotic hyperostosis and the orbital lesions as cribra orbitalia, it is important to bear in mind that similar lesions can be produced by other pathological conditions, and therefore differential diagnosis is needed. For example, in scurvy the bleeding that occurs in the soft tissues in association with the skull stimulates the periosteum which forms woven bone that simulates porotic hyperostosis. However, the cross-sectional morphology of this lesion does not produce a significant change in the width diploic space (which increases in anemia) or the outer table, making diagnosis possible (Ortner, 2003: 55-56). Light microscopic analysis can also help provide a reliable diagnosis in these cases (Schultz, 2003). According to Roberts and Manchester (1997) porotic hyperostosis is seldom observed in Britain and it does not tend to be present without orbital lesions; this is the reason why porotic hyperostosis was not studied in this research. The emphasis is on the orbital lesions (cribra orbitalia) because they are more frequently observed.

2.2.3.1.1 Cribra Orbitalia:

(i) Introduction

Cribra orbitalia consist of small apertures or foramina that appear on the orbital roofs (Figure 2.3) which gives the bone a porous appearance (Stuart-Macadam, 1991; Wapler *et al.*, 2004). The bones are usually affected symmetrically (Stuart-Macadam, 1991; Roberts and Manchester, 1997). According to Stuart-Macadam (1985a) these changes are caused by the body's effort to create new red blood cells in the marrow to balance the lack of iron. The changes observed on the bone occur because of the thinning of the outer table of the skull and the expansion and thickening of the diploe (Stuart-Macadam, 1985a; Kent *et al.*, 1994; Yildirim *et al.*, 2005). The lesions vary in appearance from very small holes or openings to large ones that may be joined with others (Stuart-Macadam, 1991). On the other hand, Schultz (2001, 2003) explains that cribra orbitalia is not an independent disease, but a morphological change or evidence of several diseases or processes (for example due to inflammatory, haemorrhagic, or neoplastic processes, dietary disorders, and genetic causes, etc.).

Figure 2.3 Cribra Orbitalia in both orbital roofs (Teaching Collection Photographs, Department of Archaeology, Durham University).

Other pathological conditions, such as osteoporosis, periostitis, osteitis, rickets, and even pseudopathology (post-mortem abnormal modifications) such as post-mortem erosion of the thin orbital lamina, also can simulate cribra orbitalia (Sullivan, 2005). Erosion is only one effect of post-mortem damage, but there exist several other manifestations that range from changes produced on the bone during or after excavation to insect, rodent, water, and temperature effects (Ortner, 2003). Inflammation such as sinusitis of the frontal, maxillary and ethmoidal sinuses, tooth abscesses, nasopharyngeal infections and suppurating (pus) skin inflammation can all also affect the orbits, possibly producing dacryoadenitis and conjunctivitis which, in turn, passes the inflammation into the periosteum of the orbital roof and finally to the bone in the orbit, leaving the bony lesions that simulate cribra orbitalia (Wells, 1980; Wapler at al., 2004; Schultz, 2003).

(ii) Methods

The method most commonly used for recording cribra orbitalia was designed by Stuart-Macadam (1991:109) where illustrations of the lesions on the bone are provided and grades (0 to 5) are given (Figure 2.4) for the different types of appearance, plus areas of the orbit where the lesions can be found and recorded (Figure 2.5).

Normal 0- Normal bone surfaces.
Type 1- Capillary-like impression on the bone (capillary).
Type 2- Scattered fine foramina found on the bone surface (porotic).
Type 3- Large and small isolated foramina
Type 4- Foramina have linked into trabecular structure (trabecular).
Type 5- Outgrowth in trabecular form from the outer table surface (trabecular outgrowth).

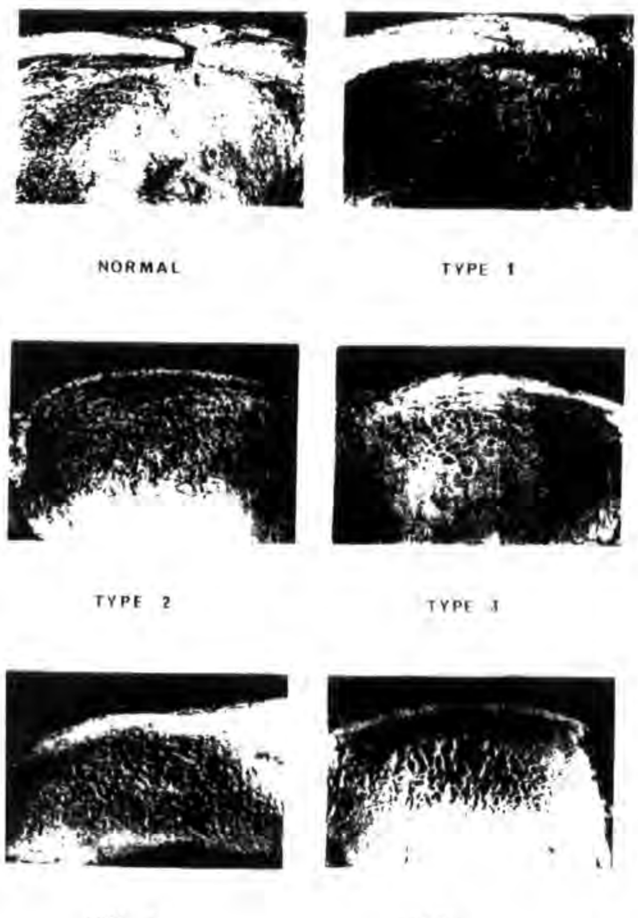


Figure 2.4 Cribra Orbitalia lesions types (Stuart-Macadam, 1991)

1= Antero-lateral sector
2= Antero-intermediate sector
3= Antero-medial sector
4= Middle-lateral sector
5= Middle-intermediate sector
6= Middle-medial sector
7= Postero-lateral sector
8= Postero-intermediate sector
9= Postero-medial sector

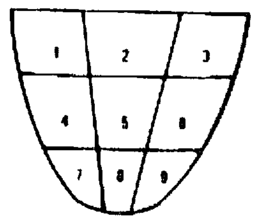


Figure 2.5 Cribra Orbitalia areas of orbit (Stuart-Macadam, 1991)

A problem with the recording of cribra orbitalia is that it is not easy to distinguish and identify active and healed lesions (Jacobi and Danforth, 2002, Sullivan, 2005). An active lesion indicates that the disease was active at the time of the person's death, and therefore no healing is observed and the edges of the foramina are sharp. The other problem with sorting the different types or grades is the morphological similarity between the grades, so it can be difficult to separate them. Of course, here inter and intra-observer error is likely to occur; Jacobi and Danforth (2002) describe that, when recording cribra orbitalia, it is easy to agree (inter-observer agreement) if the lesions of cribra orbitalia are present, but it is more difficult to refute that they are not observed. Therefore, cribra orbitalia could be recorded even if it is not present at all. Improvements in the methods of recording and presenting examples of cribra orbitalia are needed to give a better picture of this condition (Jacobi and Danforth, 2002: 256). Wapler *et al.* (2004) noted that the presence of cribra orbitalia in an individual does not necessarily mean that anaemia has caused it. Wapler *et al.* (2004) also suggest that, when studying radiographs of people with anaemia, not everybody experiencing severe anemia will display the changes on the radiograph and, if alterations on the bone are not present in an individual, this does not mean that the person did not suffer from anaemia.

The lesions could heal after some period of time or they could have had a mild form of anaemia which did not leave bone change (Wells and Cayton, 1980).

2.2.4 Tibial Periostitis

(i) Introduction

The periosteum is a thin cell layer of connective tissue (an outer fibrous layer and an inner cellular cambium) that covers the outer surface of bones, apart from areas of articulation which are covered by cartilage (White, 2000; Wenaden *et al.*, 2005); it also contains blood vessels and elastic fibers (Wenaden *et al.*, 2005). Its bone forming capacity is triggered when it is stimulated by inflammation, trauma, stress, infection, etc (Vandermergel *et al.,* 2004; Wenaden *et al.*, 2005). Wenaden *et al.* (2005: 439) explain that "periosteal new bone formation results from the induction of fibroblasts into osteogenic precursor cells. These undergo progressive modulation to develop into active osteogenic cells in the cambium". Periostitis is the result of inflammation of the periosteum (Resnick, 1995; Schultz, 2001; Aufderheide and Rodríguez-Martín, 1998; Vandermergel *et al.,* 2004; Wenaden *et al.*, 2005) and it is more often found in the tibiae of both living populations and skeletal remains (Goodman *et al.*, 1988; Roberts and Manchester, 1997), usually affecting the mid, medial, lateral and distal surfaces of the shafts of the tibia, with or without affecting the fibula (Figure 2.6).

Figure 2.6 Periostitis of tibiae and fibulae shafts from 1st century BC, Beckford, Worcestershire, England (Teaching Collection Photographs, Department of Archaeology, Durham University).

The lesions on the bone represent chronic infection which involves bacteria instead of viruses which can heal faster (Vandermergel *et al.,* 2004). The inflammation is the normal defence reaction of the body to a pathogenic agent or injury. Inflammation is actually a strong indication of a good immune system in a population or individual. Selye (1976: 213) explains that "the principal purpose of inflammation is to put a strong barricade of activated connective tissue around a territory invaded or least damaged, by some pathogen, thereby sharply demarcating the sick from the healthy". With inflammation there is reddening, heat, swelling and pain in the affected area, produced by dilatation of blood vessels in the inflamed area. The swelling is the result of leakage of fluids and cells from the dilated blood vessels into the nearby tissues and due to the abundance of fibrous connective tissue, whose cells multiply in response to irritation. Finally, pain is caused by the irritation of the sensory nerve endings that are affected by the inflammation. All these signs and symptoms could affect and interfere with the normal functions of the affected area. Signs and symptoms of periostitis would include general and localise bone pain, swelling, fever, etc, but interestingly pain could be absent in some people suffering from periostitis (Vandermergel *et al.,* 2004).

Goodman *et al.* (1988) describe tibial periostitis as an indicator of "stress" and Selye (1976) explains that inflammation is an indication that stress is/was present. However, trauma (fractures and lacerations), scurvy, stress, cancer, plus varicose vein ulceration can also produce an inflammation of the periosteum of the tibia (Larsen, 2000; Aufderheide and Rodríguez-Martín, 1998; Schultz, 2003; Vandermergel *et al.,* 2004). Nevertheless, trauma as a causative factor of tibial periostitis can be disputed, especially when bilateral tibial periostitis is present; this could indicate that both tibiae suffered trauma at the same time, but injuries of one of the tibiae are more common than bilateral injuries (Larsen, 2000; Aufderheide and Rodríguez-Martín, 1998). On the other hand, Vandermergel *et al* (2004:376) report that individuals who showed unilateral periostitis secondary to stress fractures appear to develop bilateral periostitis for no reason. Furthermore, increased vascularization in periostitis results in impressions on the bone surface which can be observed in skeletal remains (Wapler *et al.*, 2004), but new bone formation is also deposited under the affected periosteum. This new bone is initially porous and disorganised (woven) and then dense and sclerotic (lamellar), and the subperiosteal bone eventually merges and is incorporated into the underlying cortex (Rogers and Waldron, 1989). Additional to the new bone formation, pitting and longitudinal striations can also be present and are characteristic features of tibial periostitis (Goodman *et al.*, 1988; Resnick, 1995).

Pitting on the bone is considered an indication of the earliest stages of the disease (Rogers and Waldron, 1989). New bone formed in the later stages could be woven (active) or lamellar (healed) in structure. The bone formed can be smooth, striated or mixed or there may be plaques of new bone (Rogers and Waldron, 1989; Roberts and Manchester, 1997). Rogers and Waldron (1989) suggest that the 'sabre' shape tibia is the most characteristic morphological change in periostitis. In this case, the anterior area of the tibia shaft is expanded with new bone formation and forms, or gives the appearance of, an anteriorly curved shaft.

(ii) Methods

Today, periostitis can be observed on radiographs, bone scan, MRI (magnetic resonance imaging), etc (Vandermergel *et al.*, 2004; Wenaden *et al.*, 2005). However in skeletal remains Roberts and Manchester (2005) suggest that periostitis, particularly subtle lesions, is often not seen in radiographs. The appearance of periosteal reactions on bone varies depending on the degree of intensity, aggression and duration of the aetiological factor (Wenaden *et al.*, 2005). A possible method of recording and diagnosing tibial periostitis on skeletal remains comprises the following. Beyond observing the type of bone change (see above), if the periostitis covers much of the bone surface, it is tibial periostitis caused by infection, inflammation and stress. If it covers a part or localized area of the bone surface, it is probably a localized injury or due to an overlying soft tissue ulceration spreading to the bone (Vandermergel *et al.*, 2004). The recording should include: the bone affected, the side (right or left) of the body the bone derives, the location of the lesion, the type of bone formed (woven, lamellar or a mixture) and finally a differential diagnosis of periostitis, osteitis and osteomyelitis (Resnick, 1995; Roberts and Manchester, 1997). For various periosteal reactions see Ragsdale *et al.* (1981) and Resnick (1995).

For reasons of differentiation between periostitis, osteitis and osteomyelitis a brief explanation will be given of osteomyelitis and osteitis. Osteomyelitis is infection of the medullary cavity of bone, and therefore it affects the inner part of the bone (Figure 2.7). Berbari (2006) indicates that osteomyelitis is the outcome of haematogenous or contiguous microbial seeding of the bone (*staphylococcus aureus* is the most common infecting microorganism). The infection starts on the metaphyseal side of the growth plate (most rapidly growing parts of the bone) and produces a suppurative inflammation with pus (pyogenic). Sinuses or cloacae are formed in the involucrum (sheath of new bone formed around the cortex) for the drainage of the pus from the infected bone and bone marrow (Berbari, 2006). Osteomyelitis can be caused by spread of an infection through the bloodstream from an infection at a distant site or even an adjacent site; e.g., dental abscess or a soft tissue injury (Rogers and Waldron, 1989; Resnick, 1995; Schultz, 2001, 2003; Aufderheide and Rodríguez-Martín, 1998; Ortner, 2003; Berbari, 2006). Today, confirming diagnosis of osteomyelitis involves bone biopsy and bone culture tests (Berbari, 2006). On the other hand, osteitis refers to infection of the cortex of the bone and it is characterized by thickening of the shaft of the bone, producing an occlusion or narrowing of the medullary cavity. Radiographs are usually needed to observe the thickening of the bone cortex (Rogers and Waldron, 1989; Resnick, 1995; Aufderheide and Rodríguez-Martín, 1998; Schultz, 2003).

Figure 2.7 Osteomyelitis of the right tibia from Early Medieval Eccles, Kent, England (Teaching Collection Photographs, Department of Archaeology, Durham University). Note sinus (arrowed).

A problem with tibial periostitis is that some diseases can also produce periostitis and destruction of the bone as part of the process; e.g. neoplastic diseases, and leprosy and treponemal infections (Rogers and Waldron, 1989; Aufderheide and Rodríguez-Martín, 1998; Vandermergel *et al.,* 2004). Schultz (2001) recommends the used of microscopic techniques to diagnose disease in ancient bone, which may help in the specific diagnosis of periostitis. It is also sometimes problematic to distinguish between the conditions (periostitis, osteitis and osteomyelitis) as the vascular supply in a bone may lead to infection in different parts, one condition passing imperceptibly into another. Wells and Cayton (1980: 273) indicate that infections are difficult to distinguish in archaeological material as post-mortem soil erosion can produce similar changes.

2.2.5 Age at Death Profile: A Note

(i) Introduction

Knowing the age at death of skeletal remains is fundamental to the study of paleopathology, paleodemography, fertility, etc. However, issues of the accuracy of the estimation of age at death of adult skeletons from archaeological sites are surrounded by controversy and it is considered by many as unnecessary. Initially, this is because of its inaccuracy, unreliability and imprecision, as the methods imply that the rate of degeneration of particular areas of the skeleton in the past is similar as that of modern population, but diet, activity, sex, genes and environment determines the rate which people grow and age (Wood *et al.*, 1992; Molleson and Cox, 1993; Roberts and Manchester, 1997; White, 2000). In addition, there is individual variation between people in the rate and timing of development; in other words, individuals of the same chronological age could show different levels of development (White, 2000). Interestingly, females (juveniles and adults) mature about one to two years earlier than males, For example, epiphyseal union starts earlier in females than males.

Another problem with age at death determination concerns inter and intra-observer error (between and within, respectively) in the estimation and recording of age. Methods of ageing adult skeletal remains are affected by the condition and preservation of the skeletal remains, for example, the skeletal element needed to apply a particular ageing technique may be absent or damaged. The dental attrition ageing technique is also complicated by the fact that dental wear can be caused by diet and other mechanical factors such as the use of the teeth as tools (Miles, 1963; Beckett and Lovell, 1994; Lovell and Lai, 1994). For example, Lovell and Lai (1994:331) illustrate that dental wear can be produced by the habitual clenching of a pipe stem. On the other hand, Millard and Gowland (2002) have recently developed a Bayesian approach to the determination of age at death by tooth wear to control for factors affecting dental wear; both stage of development of the upper permanent dentition and lower incisors and molar wear were recorded; through Bayesian analysis of the data ranges for ages from birth were obtained which provided a practical age estimation with minimum underestimation of age.

The most common method of estimating the age at death of skeletal remains are listed in Chapter six (Material and Methods). Due to time and word constrains, details for each ageing technique is not discussed. Most of the methods used are based on morphological factors and changes observed in relatively modern populations (early 20th Century) (Terry Collection and Hamann-Todd Collection) where individuals have known ages at death. These factors are then correlated with a particular or general age provided by the method. It is important to remember that the mean age at death obtained through the used of these ageing methods can only be approximate; it is not an absolute or chronological but a biological age (Waldron, 1994a). In bioarchaeology, ageing juveniles is easier than ageing adults, by comparing modern rates of dental and skeletal development to that seen in skeletal remains a possible age can be inferred (White, 2000). On the contrary, ageing adults is difficult when full dental and skeletal development has occurred, generally after 25 years of age (Roberts and Manchester, 2005). In other words, it is impossible to assign a specific age to an adult individual, because the developmental changes associated with particular age would be erased as the person gets older, in addition factors such as occupation, diet, environment, ethnicity, genetic makeup, and diseases can take over bone development and affect it (White, 2000; Kemkes-Grottenthaler, 2005). The recommended approach to obtain the most accurate age estimation for adults is to use as many methods as possible (Bedford *et al.*, 1993; Cox, 2000; White, 2000). In this research the construction of the age at death profile for each period was done to give a general picture of age at death for specific time periods, but it cannot be considered a representation of the population as a whole. However, no relationship was established between the age at death provided and dental and skeletal indicators of stress studied. As all the limitations have been noted, it would be tempting to avoid studying age at death during the three periods studied, however, most skeletal reports provided some age at death data which provided an extra factor to be considered and compared.

In the next chapter the Romano-British period is introduced.

Chapter 3: Romano-British Period (AD 43- AD 450)

3.1 Introduction

In 55 and 54 BC Julius Caesar and his army landed in England, having an impact on the people who lived there (Williams, 1994a; Steele, 2001). Battles were fought between the Romans and the ancient Britons. Before leaving England, Julius Caesar took several British hostages and arranged for the population to pay tax (Williams, 1994a; Steele, 2001). Despite these events, between 55 and 20 BC the first pre-conquest Roman imports (wine amphorae and metal drinking devices) had started to arrived in Britain through exchange networks (Haselgrove, 1999; Bennett, 2001), particularly, in the area of Essex, southern and eastern Sussex and the border areas of Hertfordshire and Cambridgeshire where the tribe of the Trinovantes were still Rome's allies (Hingley, 1989; Williams, 1994a). However, it was not until about 20 BC that Roman influence increased, especially in the south-east of England. Roman culture was being established in northern France enabling easy access to the southern regions of England (Haselgrove, 1999). Figure 3.1 shows a map of Britain during the Roman-British period; note the number of urban centres in the south-east of England.

Figure 3.1: Map of the Romano – British Period
(from the project Gutenberg Ebook , 2007)

In AD 43 the emperor Claudius invaded Britain again, resulting in a clear change in the political, social and economic structure of Britain. The Emperor Claudius needed to secure his position as new emperor and increase the power of Rome through victory in battles, as well as establishing a strong trading system between all the provinces of the Roman Empire (King, 1991; Williams, 1994a; Steele, 2001). Bennett (2001:7) suggests that "Rome's guiding principle in ruling her dominion (Britannia) was to adapt indigenous forms of authority to her own requirement. The Roman empire was sustained not by exploiting the provinces, but by fixing them in a specific alliance with Rome". Following this guiding principle, many British tribes (particularly in the south and east of England) that had expanded their lands and power through large settlements, allied themselves with Rome in an attempt to retain their power (Williams, 1994a). Authority was given to some local tribal leaders who were Roman allies, securing in this way, coalition with Rome and the adoption of Roman ideals within the local leaders and elite, some of these local leaders or rulers that accepted Roman influences were Prasutagus of the Iceni, Cogidudnus of the Regini, and Cartimandua of the Brigantes (Bennett, 2001).

By around AD 49 Colchester (Camulodonum) that was originally a settlement for legionary veterans or retired soldiers, was made the capital of Britannia. A statue of Claudius and images of Roma and Victory erected to celebrate the conquest of Britain, have been unearthed there (Bennett, 2001). London (Londinium) became the business and trade centre due to its strategic location by the river Thames. A bridge was built across the Thames and a port-town was established, on the northern bank of the river (Williams, 1994a). London was a large and wealthy place, with organised streets and roads and with a large population of traders, military officials and Roman citizens (Bennett, 2001). By AD 100, London was the capital of the Roman province and as the other major towns was governed by a council that collected taxes on goods sold.

In AD 60 the Iceni tribe of Norfolk, led by Queen Boudicca and the Trinovantes tribe, who had occupied Colchester, attacked and burned Colchester, London and St Albans (*Verulamium*). Between 70,000 and 80,000 Romans and Britons were killed during the Boudiccan Revolt. At the end of this war, the Romans took a definite and determined control of southern Britain and a stable government was put in place where a reliable judiciary and military security worked and, more importantly, peace was present for many years (Applebaum, 1958; Hingley, 1989). Tribal groups living in the rural areas of Britain were integrated into the Roman Empire, helping to maintain the economy; order and security that was needed to keep and sustain the empire. The continuation of farming in the same areas that had been cultivated before the Roman conquest contributed to the maintenance of peace during this period (Applebaum, 1958; Grant, 1989; Jones, 1991). In the south and east of England, cattle-rearing and wool production also continued in the same fashion after the Roman Conquest, only changing and increasing in productivity later on during the Romano-British period (Grant, 1989). However, it is relevant to remember that by the second half of the third century, civil war, barbarian invasion, over taxation and inflation contributed to the decline of rural life in some areas of Britain (Applebaum, 1958:83).

By AD 100 in many parts of Britannia (for example, the northern area) frontier forts, with an established Roman army garrison, were created to keep watch on the native tribes (*civitates*) and to protect the urban centres. Local government areas were created where a council of chieftains and landowners (usually British tribal leaders) controlled the land and collected taxes and contributions. This of course, helped to maintain the peace (Applebaum, 1958; Hingley, 1989; Williams, 1994a) and helped in the development of a strong market economy (Hingley, 1989). The taxes collected were used to pay local expenses and a share was also collected for Rome.

It is very difficult to know exactly how large the population of Britain was during the Romano-British period. However, judging by the number of Roman settlements found, it is believed that between four and six million people lived in Roman Britain. In other words, it was a heavily settled landscape, in particular in the lowland areas of the south and east of England (Hingley, 1989). By the early second century AD around 50,000 soldiers were stationed in Britain (Bennett, 2001). After the Roman army conquered this area (south and east) a civilized urban society developed. Many businessmen arrived from the continent, and freedom of movement around the Roman Empire allowed these men to come and go from Britain, bringing with them goods, ideas and a new culture (Bennett, 2001).

Villas were created in the countryside and many people lived in a rural environment. Bennett (2001:56) places the latest rural population estimate at about 2,500,000 people, while merely 250,000 people lived in urban or town centres (Hingley, 1989:3). During the third century AD the population of London was about 30,000, other important cities (Cirencester and Wroxeter) had around 20,000 each, while other smaller urban centres had about 7000 inhabitants (Bennett, 2001). According to Bennett (2001:61), it is possible that the total number of urban burials in Britain during the four hundred years of the Roman occupation was around eight million. This increase in population was closely related to economic growth that was evident through increased production, consumption and trade seen throughout the Roman Empire (Applebaum, 1958; Hingley, 1989). As an example, Grant (1989:138) suggests that "the steady increase in the importance of cattle throughout the Roman occupation may reflect the needs of an expanding population requiring larger or more intensively cultivated areas of land". On the other hand, of relevance is that around AD 367 the Roman army was moved to coastal areas, leaving some of the countryside unattended which prompted economic disturbance and political problems, with some insecurity and impoverishment found (Applebaum, 1958).

3.2 General Environment and Climate during the Romano-British period.

Dobney *et al.* (1997: 18) indicate that the evidence from plant macrofossils and invertebrates (dung beetles) suggest that the south and east of England was mainly grassland with rough pasture resembling pasture woodland. Since the Iron Age and later during the Roman-British period, the lowland landscape of the south and east of Britain was intensively settled and exploited and there were probably no unpopulated areas between the main towns and local centres (Hingley, 1989:3 and 105).

Most of the fertile areas that were already exploited and settled during the Iron Age were occupied again by the Romano-British population, continuing and expanding their production to the few areas that were not heavily developed and exploited. However, the upland or military zones of Britain (for example, northern, western and central Wales, Cumbria and Northumbria) did not develop as well economically as the lowlands, and the lack of villas and towns is a characteristic of these regions (Hingley, 1989; Jones, 1991). It is believed that the poor soil and wet and cold climate of the uplands may have been the main factors for this absence of villas and towns in these areas (Applebaum, 1958; Grant, 1989; Hingley, 1989).

During the Roman conquest of England, climate was 1°C warmer to that of today (Simmons, 2001: 53). However, a climatic deterioration occurred in the latter part of the Roman occupation of Britain as there was an increase in annual rainfall and a decrease in temperature, during winters and summers, both of which affected the soil and crop production (Applebaum, 1958; Simmons, 2001). However, these climatic changes encouraged a reliance on stock farming and the cultivation and production of wheat, which has more resistance than barley to moist and wet environmental conditions (Applebaum, 1958:84).

3.3 Living Environment: The Rural Setting

Most people during the Romano-British period lived in a rural environment. People lived either in single, isolated compounds or houses, or in a group of compounds or houses. For example, in the south and east of Britain, non-villa settlements were common. These settlements varied from village type communities, small and large hamlets, to the single farmhouse, usually occupied by slaves or tenants (Hingley, 1989). Non-villa settlements also varied in size and structure, depending on the function and number of people that occupied them. An agricultural function is usually associated with these types of sites. The land around the non-villa settlements usually had rich and productive soils. Before continuing with a description of the structures of the settlements, it is important to note that many of the explanations made about housing, settlements and living conditions are biased in interpretation, because of the problem of evidence not being preserved in its entirety (Meadows, 1999).

Rural settlements were diverse in form and structure with some dwellings being more elaborate than others. During the first and second century AD, many houses were similar to those from the Iron Age. Houses consisted of round, sometimes oval or elongated huts that were usually smoky and draughty. In southern Britain some settlements consisted of one or more round huts surrounded by a wall or ditch (Hingley, 1989). However, unwalled sites were also common. Urban and rural houses were built of timber and wattle-and- daub with thatched roofs. These houses served different functions (habitation, storage, place of worship and industry). A hearth was placed in the centre of the hut, as had been done before by other societies. The construction and use of a hearth in the house is an indication of domestic use as is the presence of food production artefacts and storage rooms (Hingley, 1989; Meadow, 1999). Floors mainly consisted of hard-beaten earth (Steele, 2001). Other round houses were built of stone with tile and slate roofs. The variety of materials used for the constructions of homes may imply social status (Hingley, 1989:31). Round houses continued to be built into the third and fourth century AD (Hingley, 1989; Meadows, 1999).

Initially during the Iron Age, and into the first to 3rd centuries AD there is evidence that house shape changed from round to rectangular, but this was not widespread (Hingley, 1997; Meadows, 1999). According to Hingley (1997) keeping the round structure was a statement of identity and resistance from local people to Roman influences; however, this is difficult to prove. On the other hand, changing the shape of the house from a round to a rectangular structure as seen in villas, could be seen as a symbol of acceptance by individuals, families or the community of Roman and/or continental standards, norms and customs (Hingley, 1989:34 and 157) However, the acceptance of the rectangular structure could have been done for the sole reason of protecting their possessions and settlements from Roman officials (Hingley, 1997; Meadows, 1999).

The rectangular house consisted of rectangular blocks of either one, or more than two, rooms. One roomed houses did not have supplementary corridors, while some of the two or more roomed houses included corridors to allow access to the other rooms in the house. A hearth was usually placed in the largest of the rooms. Again, both types of rectangular houses could have been built of timber and daub with thatched roofs, or with stone foundations and timber walls, or they may even have been built completely of stone (Applebaum, 1958; Hingley, 1989). Small plots of land for intensive cultivation also appeared during late Roman period and these plots could have been used for either production for subsistence or for sale on markets (Jones, 1991). The main room was probably used for living, eating and sleeping while the other rooms could have been used only as a private sleeping quarters. Hingley (1989:39) explains that the increase in the number of rooms in a house, and the construction of a corridor, may have served to separate the head of the household from the other family members, or to separate the family from the servants. Applebaum (1958:76) suggests that perhaps the different rooms separated the family from the animals and livestock.

"Compound" settlements were also evident during the Romano-British period. In this kind of settlement two to five buildings, or even more, were grouped together to comprise a whole farm. Villas could also be grouped together to form compound settlements. Some of the outbuildings in compound settlements were used for residential purposes, others for agricultural and storage (Applebaum, 1958). Storage and granary facilities indicate production, distribution and consumption of goods (Jones, 1991). Compound settlements could have been enclosed or open. An enclosed compound farm was probably surrounded by a bank or ditch, earth and timber and, in some cases, by stone walls. The materials used to make the enclosures depended on what was available in the area of the settlement (Hingley, 1989). Stone walls were used if there was easy access to local bedrock, while the bank, ditch, earth and timber option was used when stone was not available. Wells for water were also constructed at some of the farms as having a water supply at close proximity helped in the running of the house, looking after the animals and for carrying out the agricultural basics. Byres, stables, and sties were built to house animals such as cattle, horses and pigs not only during the summer months but also during the winter period (Applebaum, 1958).

Leporaria, were also built as enclosures to keep hares and rabbits (Brothwell and Brothwell, 1998: 49).

By the first century AD, 70% settlements were composed of single farm compounds but by the late second to early third century this had reduced to 35-40% (Hingley, 1989:76). The higher number of compound settlements with more than one house during the first century AD brought with it deterioration in standards of drainage, a problem that helped in the development of new single farm compounds once again (Hingley, 1989).

Evidence for the form of particular buildings such as houses with multiple rooms, along with the emergence of domestic buildings in compound settlements and farms has, been used to suggest that the family structure found in rural settlements sites with both villa and non-villa settings were consistent with extended families. Here, basic nuclear family groups (father, mother and dependent children) of two or more generations with a common father or mother and ancestor lived and shared a house, land, farm or settlement, securing in this way continuity in the management of the land (Applebaum, 1958; Hingley, 1989). On the other hand, a small house or dwelling may have represented a single nuclear family unit. However, some caution is recommended here as an extended family group could have lived in a small dwelling or a nuclear family could have lived in a compound settlement.

3.4 Living Environment: The Urban Setting

As previously discussed, the population was growing as people settled, and the demand for food and raw materials increased (Grant, 1989). Towns were crowded, especially, towns near to military areas (forts), market places, administrative buildings, religious and trading centres. These towns usually developed close to a local tribe's pre-Roman social, religious or political centre, as well as ex-Roman army bases (Bennett, 2001). Living within the established economic, social and political system increased the chances of having a prosperous life (Grant, 1989; Bennett, 2001). As mentioned previously, towns were formed in these market and trade centres but also in areas that used to be owned by tribal communities, for example the territory of the Trinovantes in Essex. However, most land was left in tribal hands. A characteristic of these centres was the presence of (usually) a well maintained paved and metalled street and road system which in some cases divided blocks of properties. Examples of this type of site come from Baldock, Hertfordshire and Silchester, Hampshire (a civitas capital) (Hingley, 1989). Many amenities have been found in these towns such as amphitheatres, plumbing (lead pipes) to supply drinking water, baths, heating systems (hypocaust), drains, mosaics and sewers, all of which support the idea of economic growth in these areas (Hingley, 1989).

Romano-British urban settlements can also be identified by the presence of public and administrative buildings and town walls. Some of these important buildings (basilica and temple complexes, market halls and even open market areas) were located in the centre of the settlement or town. An official, industrial, economic and religious significance could be given to the placement of these buildings in the centre of the town (Hingley, 1989). Hingley (1989: 90 and 91) gives the examples of some of these sites in Britain: Water Newton, Cambridgeshire; Stonea, Cambridgeshire and Dorchester-on-Thames and Oxfordshire. Other urbanized centres in Roman Britain were military bases and these forts and fortresses lacked public administrative buildings. A local unit commander, retired veterans and soldiers lived in them, but by the third century AD soldiers could legally get married which contributed to the expansion of its population.

After their dissolution as a military setting, many of them became towns and the land around them was cultivated (Bennett, 2001).

Some houses in towns were built with timber frames and wattle and daub walls, while others were constructed with a combination of stones (ground floor), bricks and wood. Floors were made of clay, chalk or gravel and walls prepared with plaster and paint. Some roofs were covered with tiles or slates made of terracotta (Hingley, 1989). Remains of a brickwork establishment and a tilery have been found in London and Gloucester respectively (Bennett, 2001). Throughout the day, light came through windows that typically were covered either by glass or wooden shutters and bars. During the night oil lamps and candles were probably used. There is evidence that a small oil lamp factory existed in Colchester before AD 60 (Bennett, 2001).

Compound settlements with rectangular houses are also found at local market centres with multiple groups of compound settlements occurring in the same area. An example of this has been found at Ashton, Northamptonshire were at least ten buildings can be seen. As suggested, some buildings were probably used for domestic, storage, industry or other important activities. This kind of establishment became very important especially during the winter months as everything was in close proximity to living quarters, allowing easy access and maintenance of livestock and pastures (Applebaum, 1958). Byres to keep cattle in town centres were built in order to keep a supply of milk close by, but also for the use of transport of heavy loads (Grant, 1989). The hypocaust system was mainly directed to the dining room of the house and it consisted of an outside furnace creating enough hot air that eventually was directed through pipes and under-floor channels to the house. The under-floor channels were created by pillars of tiles or stones that also held up the floor.

Dobney *et al.* (1997:19) suggest that Roman urban occupation seems to have led to sterilisation of the external surfaces (e.g. streets, ponds, etc) in occupation areas, most likely as a result of low input of organic matter and organised cleaning and waste-disposal.

3.5 Romano-British Trade

The Romans brought to their British province (England and Wales) architecture, law, religion, fashions and more importantly a home life. Both Romans and Britons exchanged knowledge and customs. The population in the towns increased and, with it, the necessity of reinstating and improving farming to support the population. The Romans introduced a more efficient method of food production and storage that supported the trading system (Bennett, 2001).Trade and market exchange with the continent increased as Britain usually exported grain to the continent. According to Applebaum (1958:81) evidence of this activity can be seen from the large number of grain drying furnaces found in villa settings. Traders and costumers from all around the Empire were attracted to the trade and market centres in Britain as pottery, food, silk and silverware were brought to England. By the fourth century AD, woollen goods and different kinds of textiles (hairy pigmented wools and fine true wools) produced in Britain were also exported to the continent (Grant, 1989). Bennett (2001: 42) calls the wool "Britannia's most valued trading commodity in Roman times". The windproof and waterproof qualities of the British woollen cloths were recognised by the Roman army and people in the northern areas of the Roman Empire (Bennett, 2001).

In the south- east of England, merchants from all Europe (Roman Empire) were found. Trade and exchange networks were also formed in inland Britain. Roads were built all across England, some as military routes, but they also helped in the development of a communication, exchange and trade system, linking towns, local markets and military posts, and enabling the transport and distribution of products and goods (Applebaum, 1958; Jones, 1991; Hingley, 1989). Major and small towns were positioned along these roads. The importance of these trade networks can be seen when studying some of the poor settlements in the area as the amount of pottery and metalwork found on them suggests a continuous and stable trading and marketing system where local markets were reached easily by rural peasants and farmers (Hingley, 1989). In the south and east of England, London and Dover, in Kent, were important Roman ports, especially for cross-Channel trade. As a result, many quays, warehouses and lighthouses were built to support trade and industry (Hingley, 1989; Bennett, 2001).

Many products were produced in Britain as the land was rich and fertile. Products included wool, cattle, grains, cereals, pearls, leather, and metals (silver, lead, and copper and iron ore from the southern Weald (Kent, Surrey and East Sussex), and stone and turf (Applebaum, 1958; Grant, 1989; Bennett, 2001). As indicated by Bennett (2001:38) a statement about Britannia given by Eumenius around AD 296 shows that: "land (Britannia)...so profuse are its harvests, so numerous the pasturelands, so many the metals to be mined, so profitable the taxes". In addition, slaves and hunting dogs were also exported from Britain to other parts of the Roman Empire.

As long distance trade increased, and became more established, many goods were imported from the Continent, as a desire for new exotic goods, luxury, technologies and comfort was recognised (Hingley, 1989; Jones, 1991). Many products and manufactured goods came from Gaul but also from other parts of the empire such as Tuscany, Italy and Tunisia, North Africa. Pottery, herbs, spices, dried fruits, wine, olive oil, and fish sauce stored and shipped in amphorae all reached Britain during this period (Brothwell and Brothwell, 1998; Meadows, 1999).

Some of the best quality mass produced pottery was also imported to Britain. Red-gloss pottery (Arretine Ware) and Central Gaulish samian ware reached the wealthy people of the south of England by the first century BC and soon after the Roman conquest (Bennett, 2001). Local pottery was also produced to supply the regional urban and military centres. An example of this are the black-burnished wares produced in the south-west of England and in Essex during the second and third centuries AD, the pottery of the Oxford region and the later New Forest pottery that were distributed to the urban centres of London, Winchester, Chichester, Cirencester, Silchester, *Verulamium* and Leicester (Bennett, 2001). Moreover, trading in pottery included copies of expensive beakers and pots. Copies of expensive silver bowls and platters made of polished pewter were also produced, implying a wish by rural and urban communities to have similar possessions as the rich people (Meadows, 1999; Bennett, 2001). Hingley (1989:11) indicates that production of goods increased during this period and the evidence is seen in pottery and other goods found even in poor settlements. Imported glass in a wide variety and forms from the same areas has also been found.

Gold and coins were used to pay for trade in markets within the province of *Britannia* and the whole Roman Empire (Hingley, 1989; Meadows, 1999). The supply of coinage was relatively regular and standardized, although deflation and supply difficulties occurred from time to time. Markets occurred on different days of the week at different locations (market weekly cycle or circuit), supporting in this way the travels of the trader and farmer around each centre (Hingley, 1989). In the market areas, permanent and mobile commercial premises where trade and manufacture activities occurred were present. Permanent structures included shopping arcades, small shops and single rooms facing the main street. Examples of these structures have been found in Cirencester, Leicester and *Verulamium* (St. Albans). Mobile commercial premises consisted mainly of timber framed market stalls where mostly retail trade was performed; remains of this kind of stalls have been uncovered in Wroxeter (Bennett, 2001). Without a doubt, the monetary stimulus encouraged local farmers to increased cultivation and produce crops (Jones, 1991).

Through trade, the Romans not only imported goods to Britain but also various animals such as cattle, horses, pigs, grain pests, cockroaches, and rats (Applebaum, 1958; King, 1991; Brothwell and Brothwell, 1998; Dobney *et al.*, 1997). Places such as ports, where a lot of refuse accumulated, and where boats or vessels coming from the continent arrived, were highly populated by the black rat (*Rattus rattus*) which, in turn, probably originated in areas where the boats derived (Dobney *et al.,* 1997). Bones of a large breed of horse have been found in some Romano-British sites (for example, at Corbridge, Northumberland) with the origin of this horse being traced to Gaul and Germany (Applebaum, 1958; Grant, 1989). Brothwell and Brothwell (1998:47) describe the white Chillingham herd, which is a long horn type of cow, as being brought to Britain from Italy. Grant (1989:142), and King (1991:16) describe new larger breeds of animals occurring (e.g. pig, horses, cattle, sheep and dogs in the southeast (a highly Romanised zone) and in the north (a Roman militarised zone) of Britain at this time which could indicate contact with the continent and new animals or stock being brought to Britain. However, the increase in animal size could have also been a product of breed differences, improved nutrition (good quality pasture and more intensive cereal cultivation which increased the amount of fodder for feeding), sexual dimorphism, selective breeding of existing stock, or a combination of several of these factors (Grant, 1989; King, 1991).

3.6 Diet and Economy

People of different backgrounds eat and drink in culturally specific ways and Meadows (1999: 105) discusses that "what and how we consume is socially, culturally, economically and politically motivated". During the first contact between Romans and the native population of England, some stressful situations may have occurred as far as diet was concerned. The native population was introduced to Roman food, and in the same way Romans were introduced to native foods. Likes and dislikes of food occurred and an imbalance in the amount of nutrients obtained could have been affected. However, it is possible that for a few years diet did not change much as local animals and plant produce were available and consumed (King, 1991:23). Agriculture, for example, continued in the same pattern that had been established in the later Iron Age (King, 1991). There is a possibility that the Roman army, For example, moved to areas that were already productive and did not have to start crop and animal production afresh (Jones, 1991:25). A significant outcome of the Roman Conquest of Britain was that there was an influx of people (the Roman army for example) that were consumers and not producers of agricultural products (Grant, 1989)

When compared to the previous Iron Age, life during the Roman period, more precisely during the third and fourth century, was more stable, with a considerable improvement in the quantity and quality of food, especially for urban dwellers and soldiers. For example, herbs and spices were brought to Britain from North Africa, and animals from Spain (Dupont, 1992). Some of the imported and local herbs and spices used were dill, mint, thyme, cumin, rue, rocket, mustard seed, poppy seeds, sesame, bay, anise, fennel, pepper, salt and parsley (Brothwell and Brothwell, 1998), of which most reached the rich members of the society.

Artefacts, structural and environmental evidence related to crop production, cooking, eating and drinking are usually found concentrated around and inside houses or/and settlements sites at this time. These encompass remains such as those of animals and plant, hearth stones, quernstones, implements to work the land, structures, buildings, fields and plots showing traces of cultivation, and pottery used to prepare, store and serve food. The preservation of all archaeological evidence depends on many factors and conditions such as arid and cold areas, peat bogs and carbonization by heat could all help to preserve these ancient materials (Jones, 1991; Brothwell and Brothwell, 1998). As for plant remains, "food plants become markedly less discernible in archaeological terms during the stages immediately preceding consumption" (Jones, 1991:25). For example, major groups of plants such as cereals which were consumed whole, cracked, rolled or milled can be easily distinguished in some of these states of production (Jones, 1991:25).

The type, amount and quality of food eaten during the Romano-British period varied significantly (Richards *et al.*, 1998). For example, bread and porridge was the staple food for the majority, along with cereals, fruit, vegetables, and meat for people in rural areas. However, for the town-dwellers there was a greater variety of foods available in local shops, taverns and markets. For example, remains of white and brown bread, nuts, shellfish, oysters, fish sauces, fish and edible snails have been found in some Romano - British settlements (Lauwerier, 1986; Brothwell and Brothwell, 1998; Meadows, 1999). Another example of the varied food of the time are oysters, for example, the Romans used the oyster hanging culture method to harvest oysters, where ropes were attached to horizontal pieces of wood, allowing the oysters to attach themselves on the rope in rich but sheltered waters (Brothwell and Brothwell, 1998:66). Oyster production increased from the early to late Roman period, production starting in the southeast coast of Britain and spreading inland, supporting not only an organised food production but also a stable trade and economic system (King, 1991). Flower and Rosenbaum (1958) provide Roman recipes for sauces that could have been eaten with oysters, fish and mussels. Fish consumption increased in the Romano-British period (Grant, 1989; King, 1991).However, Grant (1989:144) warns that in Romano-British archaeological sites, identification of fish remains is hampered by inadequate recovery techniques; the small size of fish bones are not easily preserved and recovered, in addition there seem to be the lack of attention on fish remains by specialists. However, more recently archaeologists are focusing more on the recovery of animal remains.

It is believed that during the Roman period, some people, usually the rich and city dwellers, had three meals a day, breakfast (*ientaculum*), lunch (*prandium*) and dinner (*cena* or main meal). Williams (1994a:39) gives a description of what could have been a dinner banquet during this period which was usually divided into three courses "the first course might be stuffed olives, roast dormice, oysters, snails or peacock eggs. The main course might be boar's head, chicken, lobsters or pigeons. And for dessert, fruit, honey cakes and stuffed dates". Without doubt, this diet was associated with wealthy people and probably high ranking military officials. The Roman diet has been used to differentiate between social classes because what people consumed depended greatly on the wealth that they possessed. For example, it is clear that the diet of the rural peasant, urban dwellers, the military and the rich were different in amount, quantity and quality. King (1991:15) suggests that bone assemblages indicate status differentiation. For example, rich sites such as villas, could have a larger proportion of local and imported or non-native animals (cattle, pig, red deer, roe deer, fallow deer and hare) and that non-romanised sites could be characterised by the presence of fewer animal bones (sheep), indicating a low status diet. The occurrence of pig bones on a Romano-British site could also be evidence of a high status site as it they were only breed for the elite (King, 1991). Meadows (1999: 112) also suggests bread wheat in large amounts on any Romano- British archaeological site may indicate that wealthy individuals lived and consumed the wheat in the area. In Rome, wheat bread was the most common kind of bread, but barley bread was also consumed (Brothwell and Brothwell, 1998:95). The presence of the remains of nuts on Romano-British archaeological sites could also be interpreted as evidence for a higher class as nuts were considered a delicacy in the Romano-British period (King, 1991; Brothwell and Brothwell, 1998).

It has been suggested that dinner was also used as a symbol of wealth, in other words, the display and offering of various foods and drinks gave the host significance and importance within society. In addition, the seating arrangements during meals were dictated by social status. Possibly, the most important member of the house and the guest of honour, sat closer to the food and provisions while the less important individuals sat farther from the table (Williams, 1994a). It is interesting to note that most of the food was eaten with the hands, as only spoons were used on some occasions. Pottery and ceramic containers (dish like forms and beakers) found at archaeological sites indicate the type of objects used for the serving of food.

(i) Meat

Based on animal remains from archaeological sites, it is assumed that meat was abundant during the Romano-British period, with cattle, pig and sheep farming playing a significant part in the economy of this period (King, 1991; Brothwell and Brothwell, 1998; Meadows, 1999). Meats that were probably consumed during the Romano-British period were beef, mutton and lamb, venison, pork, domestic and wild fowl along with goat, boar, hare, rabbit and horse (Applebaum, 1958; Grant, 1989; King, 1991; Brothwell and Brothwell, 1998; Williams, 1994a; Meadows, 1999). Horses and dogs were not normally used for human consumption as horses, for example, were very important for the Roman army and used as riding animals. Old horses were probably sold to the peasants to be used. On the other hand, dogs could have been used for hunting and as pets. The small size of dogs skeletal remains found in Romano-British sites support the latter, as it is impossible that a very small dog was used for hunting or could have survived without any shelter or care provided (Grant, 1989).

The presence of high quantities of pork and beef, rather than lamb/mutton, in settlements may reflect Roman influences on the native population (Grant, 1989; King, 1991; Meadows, 1999). Cattle and pig rearing also increased in the south of Britain in the third and fourth centuries AD (Applebaum, 1958:74; Grant, 1989:136). In other words, beef and pork were consumed regularly during this period. The occurrence of woodland and abundant cereal waste helped the development of pig production as plenty of food to feed the pigs was available. Pigs were consumed in different ways: sometimes the stomach, liver, kidneys being spiced with salt and vinegar, or pigs were stuffed with dried figs (Flower and Rosenbaum, 1958; Brothwell and Brothwell, 1998). The consumption of domestic chicken also increased after the early Roman period (Grant, 1989; King, 1991). "Raising chickens seems to have been part of the solution to the problem of feeding the non-productive population, the army and the town dwellers, who may have raised them within the towns and the military settlements" (Grant, 1989:144).

Cut marks found on some animal remains were possibly made with choppers and knives (Meadows, 1999:111). This may indicate the removal of skin and cheek meat and the dismemberment of body parts, and that bone marrow, the tongue, cheek meat and brain tissue were possibly consumed. There was apparently well organised, ordered and centralized butchery during this period (Grant, 1989:141; King, 1991:17). In some cases, mostly adult animals were killed. This centralized killing of animals supported and followed an organised marketing of animals. Similar findings showing butchery practices have also been observed in other parts of the Roman Empire e.g., Nijmegen, Holland (Lauwerier, 1986). Brothwell and Brothwell (1998: 27) explain that bone marrow may have been consumed for a long time throughout history, the presence of splintered shafts of bone and separated proximal and distal ends of long bone may indicate this. As for the consumption of brain tissue, this could be identified from an archaeological site by the presence of smashed skulls. Skulls needed to be broken in some way to access the brain (Brothwell and Brothwell, 1998). Grant (1989:140) talks about a high concentration of cattle skull fragments in early second century context at Baldock. Charred or/and burnt bone probably indicates that some of the meat was cooked or roasted (Meadows, 1999) as the cooking of meat made the tougher food softer and therefore easier to chew and digest (Brothwell and Brothwell, 1998). Caution is, however, needed when studying animal remains and inferring diet through their study. They could also represent animals that were buried with the dead as food for the afterlife or animals used for ritual and sacrificial purposes (Lauwerier, 1986; Brothwell and Brothwell, 1998). During the Romano-British period, skulls of horses, cattle, sheep and dogs were deposited in wells and sometimes these remains were associated with human infant burials (Grant, 1989:145). Animals such as cattle also provided milk, hide and help in the transport of heavy loads (Grant, 1989).

(ii) Cereals, Vegetables and Fruits

Archaeological traces of Romano-British agriculture can be seen in remains of cultivation fields, and gardens. However, consideration that the fields could have been used for a long time, in pre-Roman times, is necessary as some of the data would be altered by it (Jones, 1991). The rural diet consisted of cereal crops which provided foods such as bread and barley soup (Flower and Rosenbaum 1958; Grant, 1989; Brothwell and Brothwell, 1998). Wheat (spelt) was the main crop, but other varieties of cereal crops included barley, rye, emmer wheat, beans and oats (Jones, 1991). Cereals were both produced locally and imported, (Applebaum, 1958). The Romans also introduced club-wheat and flax from central Europe, and consumed a lot of rye and oats. The latter of which have great resistance to cold temperatures which is the reason they were cultivated in central Europe, Hungary and Britain (Brothwell and Brothwell, 1998). Archaeological and environmental evidence from the later part of the third century AD and onwards in Britain shows that there were improvements in the agricultural methods used, especially at villa sites or in field systems around villas (Jones, 1991). King (1991:17) states that "rural sites occupied throughout the Romano-British period quite frequently show a trend to a more romanised diet by the fourth century AD, accompanied by development of romanised architecture and a villa type layout".

Granaries are a common finding in Romano-British military sites as cereals were without doubt the basis of the diet at both military and civilian centres.("a large part of Britannia's (cereals) surplus was required to feed the soldiers both on the island and in the European provinces"-Bennett, 2001:39). As mentioned before some of these foods were produced locally by civilian farmers or they were also imported from the continent; the lands around the military posts were probably cultivated by farmers and this cultivation increased year after year (Grant, 1989; Jones, 1991; Bennett, 2001).

Many fruits and vegetables came from local farms and included cabbages, lettuces, radishes, turnips, parsnips, beans, peas, mushrooms, herbs, carrots, peas, beans, celery, onions and leeks. In Italy vegetables were an affordable meal for the poor, with onions, asparagus, mustard, radishes, turnips, pulses, chick peas, and lupin seeds being consumed frequently and could have been bought in markets (Brothwell and Brothwell, 1998). In Britain, a variety of weed species and wild grasses were also consumed: edible weeds, fat hen, chess, common orache and black bindweed (Applebaum, 1958; Jones, 1991; Dupont, 1992; Dobney *et al.*, 1997; Meadows, 1999). Jones (1991:23) explains that "some of the larger weeds, such as fat hen and chess, would have been frequently harvested and eaten with cereal crop". Dobney *et al.* (1997) note that charred remains of walnut, lentil, olive and mineralised remains of grape, opium poppy, and black mulberry have been found in Colchester, Essex indicating a varied diet. Cereals that could be eaten green, fully ripe or germinated for example were parched for easy access to the edible parts, sometimes even to the point of carbonization, which contributed to the preservation of the grain (Jones, 1991; Brothwell and Brothwell, 1998). Olives were also used for their oil, but also to make fragrances and perfumes for the body (Dupont, 1992). The Roman production of olives involved different kinds and qualities, some of which were also imported (Brothwell and Brothwell, 1998:156). In Rome olives and bread were considered the staple diet of the peasant and the working classes (Brothwell and Brothwell, 1998). Olives were eaten fresh or preserved in vinegar and brine.

Nuts such as acorns, hazel, sweet chestnut, Beech mast, walnut and almond were also consumed during the Romano-British period and considered a delicacy. Their easy collection and storage allowed the popularity of nuts to develop and very often nuts were prepared to extract their oil (Brothwell and Brothwell, 1998) or eaten fresh, roasted or ground into meal.

Soldiers in Rome ate bread, porridge, beans, bacon fat, soup, cheese and vegetables as they were probably provided by Roma villas and local farms. Cheeses were also produced and several kinds of local and imported cheeses were consumed, For example smoked cheese. Eggs were preserved during this period (Brothwell and Brothwell, 1998). However, according to Dupont (1992: 125), the food that most of the Roman army consumed was to some degree inadequate, as it usually consisted of only bread and water. Nevertheless, as Applebaum (1958:74) explains, the Roman army had a least one cattle depot close to their post or place of duty and therefore they consumed beef on a regular basis. Initially after the Roman invasion of Britain the Roman army consumed local animals mutton and lamb, along with chicken, and produced cereals but later on traders, army personnel and Roman officials introduced the traditional Roman diet (pork and beef) into their fortresses and into highly romanised towns (colonies and municipia) (Grant, 1989; King, 1991:16). Evidence of this activity is seem when high percentages of pig bones are found in Roman military sites when compared to Iron age sites.

(iii) Salt, Herbs and Spices

During the Romano-British period the salt industry was well established in the south and east of Britain and it was a major export around the Roman Empire (Bennett, 2001). Salt was mined and extracted at sites such as Dymchurch, Kent; Essex area; Farnham, Surrey; Fens, Cambridgeshire; Norfolk area, and Seaford, East Sussex (Brothwell and Brothwell, 1998: 161). Salt was used as a preservative for food and to give flavour to meals. Some imported and local spices and herbs used during the Romano-British period were dill, mint, thyme, cumin, rue, rocket, mustard seed, poppy seeds, coriander, sesame, bay, anise, fennel, pepper, celery, wild turnip salt and parsley (Dupont, 1992; Brothwell and Brothwell, 1998; Meadows, 1999).

(iv) Honey and Sugar

Honey was the main sweetening agent for food and drink, and many Romans were trained beekeepers. Many farms in Italy practiced bee-keeping and the hives were placed close to water and specific plants (thyme, roses, poppies, etc) to attract bees and encourage the production of honey (Brothwell and Brothwell, 1998). Honey was also brought from Greece to Britain by the Romans. As Brothwell and Brothwell (1998: 73) state "Honey is probably the best natural source of energy available to man, and this is, of course, owing to the pure sugar content which is very easily assimilated by the body". Honey contains both glucose and fructose and in ancient Rome honey was used in the production of cakes of different sizes and shapes, desserts, sauces and dressings but also as a preservative of meat and fruits (Brothwell and Brothwell, 1998). Other sources of sugars were obtained through the consumption of *sapa* (sweet substance obtained by boiling soured wine), fruit (fructose), figs, dates and milk (lactose). The boiling process was performed in lead pots with the help of lead utensils, which in turn transferred some lead to the sapa. Interestingly, the lead acted as a sweetener and preservative (Nriagu, 1983). Applebaum (1958: 71) gives a list of some of the fruits found during the Romano-British period "cherry, medlar, plum, damson, bullace, apple, and mulberry". Grapes and grape juice were also used as sweeteners during this period (Brothwell and Brothwell, 1998). Other fruits such as apples, pears, pomegranate, apricot, dates, figs and grapes could have been brought to Britain as seeds, plants or preserved in vinegar or by drying from other regions of the Roman Empire (Jones, 1991; Brothwell and Brothwell, 1998). According to Brothwell and Brothwell, (1998: 146) figs were imported to parts of the Roman Empire from Syria and Africa, and they were popular with all classes during the summer and winter months.

(v) Drinks

The Romans introduced viticulture to Britain with evidence (vine stems) being found in Hertfordshire dating to the Romano-British period (Brothwell and Brothwell, 1998). Wine and beer were also widely consumed (Dupont, 1992) even though before the Roman invasion and in the early years of the Roman occupation beer was considered by Romans as a barbarian drink (Brothwell and Brothwell, 1998). However, all of this changed later during the Romano-British period. British beer was brewed for trade, export and domestic use in Britain and the Eastern Roman Empire (Bennett, 2001:42). In Rome, for example, table grapes were less important than wine grapes (Brothwell and Brothwell, 1998:147). The wine could have been honey wine, raisin wine, mulled wine or grape wine. Vinegar diluted in water was also drunk (Brothwell and Brothwell, 1998). Brothwell and Brothwell (1998:51-52) indicate that all Romans, also consumed normal and soured milk. Fuller *et al* (2006a:49) describe that during this period, children were receiving breast milk past the age of three years, which is what the teachings of Soranus and Galen recommended for the well-being of the mother and child.

3.7 Occupation and Social Status

The Roman conquest stimulated a growth in agricultural production and thus the economy in general. Evidence of this comes from increased numbers of late first and second centuries AD farms found, the large quantity of imported goods from the continent, and manufactured artefacts used in town and country during this time period. As mentioned, during the period, Britain became a major producer of agricultural and raw materials (metals, hides, etc) indispensable to the Roman Empire. This of course supported continental trade and the growth of local industries and population (Bennett, 2001:39). However, it is important to keep in mind that a great amount of the wealth achieved by the exploitation of both agriculture and minerals went directly to Rome because the metal ores were owned by the emperor. Yet, despite this, the standards of living improved considerably during the Roman occupation. The development of settlements and towns followed this increase in wealth, commerce and industry.

One of the pieces of evidence used to identify status during the Romano-British period in Britain is by studying the settlement patterns present during this time period (Hingley, 1989; King, 1991). Wealthy areas were characterized by the existence of villas, local market centres and towns, while poor areas are recognized by areas with non-villa settlements (Hingley, 1989:9). Villas were observed as a material symbol and indicator of status as they were productive units indicating agriculture and economic growth, exchange and consumption (Hingley, 1989). Sometimes clusters of villas were built in close proximity to local centres. Slaves were taken from the lands and states that the Romans had created in Britain and other parts of the Roman Empire and brought to the villas for labour. Often tenants or slaves worked in villas to keep the agricultural surplus necessary for the maintenance of the "establishment" (Applebaum, 1958). Applebaum (1958:78) calls it the "centralization of man power" where slaves, tenants, clients and family members were concentrated in an area such as the villa.

Produce obtained through working the land was traded and sold at local or regional markets, urban centres such as towns, and military posts. Profits were used to create new villas and maintain wealth (Jones, 1991; Bennett, 2001). Hingley (1989: 115) states that there is a correlation between the size and wealth of a settlement and the success of a market. The economic wealth was collected through the possession of agricultural land (Hingley, 1989) and no agricultural setting operated in isolation from the Roman economic and political system (Grant, 1989). Grain production increased during the third and fourth centuries AD (Applebaum, 1958), and with it probably a better standard of living. Animals (sheep and cattle) were also moved from the producing sites to the local markets or military posts to be sold. The occurrence of adult animal bones in Romano-British archaeological sites is seen by King (1991: 17) as evidence of a specialised consumption pattern where the animals were moved around to be sold in urban centres and markets. Adult sheep bones also indicate that the animals were kept not only for the meat but also for the milk, wool and manure (Grant, 1989). Indications of wealth are also suggested by the occurrence of adult animal bones in Romano-British sites. Perhaps there was not the necessity to slaughter young animals because there was enough food available and the existing pasture and fodder could be shared between the animals.

By the second century AD, the Roman economy was quite established and developed, evidence of this can be observed within the buildings of the time. Inside villas there are features that point towards a prosperous settlement, the use of stone and tile or slate in construction, the presence of mosaics, tessellated floors, hypocaust, courtyards and bath houses (Hingley, 1989: 21 and 31). The occurrence of mosaics, heated rooms and bath houses in only one specific area of the house may also indicate a status separation between the owner or landlord of the settlements and the other members of the family or tenants. Examples of houses showing this division of rooms have been found in Hampshire (North Warnborough, Thruxton and Stroud). It is important to remember that there is the possibility that family members may have had similar status and access to these important areas of the household (Hingley, 1989).

In other parts of the province (north-east and north-west areas), villas did not develop until the third century AD. In these areas, non-villa settlements may not have received the gains necessary to expand and support their populations. Hingley (1989: 124) gives three possible reasons for the stagnation of the economy of non-villa settlements. Firstly, physical factors, the poor climate, soil conditions and even over population of the area, limited the development of wealth of these areas. Secondly, it is possible that any wealth which was created belonged to the Emperor or military officials and not to the non-villa occupants who created it. Finally, perhaps the display of wealth and status was not encouraged within these regions. A reason for this lack of display of wealth could have been to avoid the payment of taxes. Therefore, some poverty was present or implied.

In the south and east of Britain tenants and slaves lived in non-villa settlements owned by villa residents (Hingley, 1989:121). Despite all the reasons given for the stagnation of non-villa settlements, the variety in form, social and economic significance of non-villa settlements could indicate that some of them were indeed wealthy settings, and perhaps just relatively poorer than the villa or town location (Hingley, 1989). Some foreign or imported artefacts, coins and wheel made pottery, have been found in some of these sites implying the possible wealth of some of them and this needs to be taken in consideration when studying status during this period. Hingley (1989:116) suggests that some of these foreign and exotic artefacts (bronze, pewter and silver vessels), could have been obtained by the rural peasant in trading centres. The addition of new areas (wings, corridors and enclosing boundaries) in a house may also indicate wealth and status, as can the possession of a large number of cattle and other animals.

With the growth of the population, and the expansion of trade and commercial manufacture, the population was encouraged to become involved in numerous industries: engineering, administration, stonemasonry, tiling, blacksmithing, goldsmithing, ironmongery, carpentry, tailoring, teaching, plumbing, milling, sculpting; of course, farmers met the needs of the growing population (Hingley, 1989; Meadows, 1999). Administrators had the responsibility of securing production and maintenance of farms as well as public buildings and amenities (Bennett, 2001). The Diocletian's Prices Edict, list some of the different salaries that were attached to some occupations in other parts of the Roman Empire: a barber could make 2 denarii per shave; an unskilled sewer-man received 20 denarii per day. On the other hand, a tailor made 30 denarii a day, a school teacher between 40 and 50 denarii per day and a lawyer 1000 denarii per case (Bennett, 2001:42).

Rural peasants were an important part of the Roman economy (Hingley, 1989) and many of them probably lived in areas in close proximity to farms or villas where they worked. Moreover, residents of a town or market area might have lived close to cultivated land, keeping up with the demands of the market (Applebaum, 1958; Hingley, 1989). However, in some areas of Cambridgeshire and Norfolk some of the non- villa settlements were located in areas where no villas and local centres functioned (Hingley, 1989). Caution, is recommended here, as the absence of villas and local centres could be due to poor preservation, or lack of excavation and archaeological research.

Domestic occupation can be implied by studying artefacts and features found in a settlement (Meadows, 1999:104). Textile remains and weaving (e.g. spindle whorls) and metal artefacts can indicate weaving or the presence of a blacksmith, respectively. Romano-British agricultural tools found in some rural settings include the sickle, the billhook, the two-hand scythe, the mower's anvil, the pruning hook, the hoe-rake, the mattock, hoes, the rake, iron spade, iron fork, turf-cutter, ox-goad, carding comb, and axe (Applebaum, 1958:73). Meanwhile, milk, leather (hides) and wool production can be inferred when studying both urban and rural Romano-British archaeological sites as the presence of mature cattle and sheep bones indicate (Grant, 1989; King, 1991). The use of cattle for their pulling power for ploughs and harrows and the carts for transport can also be inferred when studying adult animal bones (Grant, 1989). All these occupations had an important impact on the development and rise of agriculture, wool production and the Romano-British economy.

There is evidence that some farms were grouped very close together and the area of arable and /or pasture within the farms may have been work in a shared fashion between the owners of the farms. In this case the presence of a villa was not necessary as the production was shared between the communities (Hingley, 1989). Close to, and within, towns many industries and occupations may have been present. In some cases, the pottery and iron working industries were carried out in the suburbs or outskirts of the town or urban centre and Hingley (1989:93) suggests this was perhaps done to avoid smoke and risk of fire from the use of kilns for these activities.

Archaeological artefacts have been used to identify male and female activities. For example, the occurrence of spearheads, keys, knives and padlocks could indicate male activity or male presence at a site, while findings such as combs, shuttles and spindle-whorls, loom weights and other tools could indicate female occupations (Hingley, 1989: 43). However, this idea is not supported now, as it is controversial to assume that this was the case. Many of the activities previously mentioned could have been performed by both male and female individuals.

The wool industry was very important during the later Romano-British period (Applebaum, 1958), wool was considered a luxury and a high social status item, only becoming more common later on during the period (Bennett, 2001). A military presence at a site is usually associated with wealth and a high status individual while simple findings that are not too elaborate (e.g. farming tools) in design are associated with farm workers or slaves (Hingley, 1989). Applebaum (1958: 80) suggests that burial practices and customs in the eastern part of England possibly imply that wealthy land holding immigrants from the continent arrived during the late first and early second century AD. Sometimes the burials of wealthy individuals would have a tombstone with Latin inscriptions (Bennett, 2001). However, this statement is contentious as complex burial practices were already being performed in England by this time.

During the Late Roman Britain and the establishment and resulting powerful influences of the Christian church, evidence of high status and aristocracy can be observed. At this time some of the riches and possessions in Britain could be compared to those from Gaul and Italy and the example of gold jewellery and silver spoons found in a Roman temple in Thetford, Norfolk attest this idea (Henig, 1989: 230). Even though Christianity was directed at everybody of any sex and local status, many Christian leaders lived in very rich and wealthy settings (Bennett, 2001).

3.8 Access to Health Care

Evidence of access to health care in the past, can come from artistic and written records, but also from artefacts from archaeological sites such as medical and surgical instruments, and remains of medical remedies (Jackson, 2002; Nutton, 2004). Furthermore, skeletal remains may supplement these data in the form of evidence for trepanation, amputation and splinting. However, there are factors that affect all this evidence, and in particular "the survival of ancient medical literature depended on...the copying and recopying over the centuries of such writings, and the continued existence of individuals and institutions both interested in them and in an economic position to buy and preserve them" (Nutton, 2004: 4). The remains of a small hospital (*valetudinarium*) can be seen, for example at Housesteads fort on Hadrian's Wall, North of England (Breeze and Dobson, 1987) a dedication tablet such as that at Chester, north-west England from Antiochus the doctor to Asclepius (god of healing).

During the Roman period, health was believed to depend on the balance between the four humours, blood, yellow bile, black bile and phlegm (Nutton, 2004:292). The balance of the humours could be influenced by the age and diet of the person, and the season of the year and the environment could affect the equilibrium of the humours. Unconventional or divine (Asclepius, Glycon, Hygeia, Panakeia, etc) and conventional (human healing: doctors) treatment were provided. It was the decision of the sick person of what type of treatment they would look for; however, if one failed to provide healing, the other method was available (Jackson, 2002; Nutton, 2004). However, (unconventional) divine intervention was also related to the appearance of disease. It was very important to be the doctor of any influential individuals (emperor, his family, his friends, advisers, soldiers and freemen) as this work would have been a sure way to accomplish wealth and importance in society (Nutton, 2004). Many components were used in recipes to alleviate or cure illnesses; for example, Nutton, (2004: 172) describes in the writings of Scribonius Largus (Drug Recipes), who served in the Roman army that, 249 vegetables, 45 minerals and 36 animals are mentioned. Medicinal plants were grown in hospital gardens or collected in other areas, but many other plants and surgical material were brought to England from other parts of the continent such as medicated wine from Italy (Nutton, 2004). According to Meadows (1999:112) the identification of the opium poppy in Roman archaeological sites may indicate that it could have been used for medicinal purposes. Watercress eaten with vinegar was used to cure mental complaints and celery was initially used as a medicinal herb (Brothwell and Brothwell, 1998). *Radix britannica* (dock plant), found only in Britain, was used for its medical qualities (e.g. laxatives and skin conditions such as hives) all around the Empire (Bennett, 2001).

Artefacts found on archaeological sites include surgical kits with hooks, knives, scoops, forceps, scalpels and probes (Jackson, 2002). Some of the surgical operations performed by Roman doctors consisted of stone bladder removal, extraction of teeth and arrowheads, amputations, treatment of wounds, trepanations, hernias and fractures (Jackson, 2002; Nutton, 2004). Conheeney (2000a, 2000b) notes that at the site of the Eastern Cemetery of Roman London well-healed fractures were found; this may indicate the use of splints. Many deaths occurred after operations due to infection of the wound. However, wine and oils were sometimes used to clean wounds which may have helped in the prevention of infection (Jackson, 2002; Nutton, 2004). Not everybody had access to medical attention, but it is possible that the poor used their own natural remedies to treat illnesses (Jackson, 2002). Nutton (2004:186) notes that "the level of detailed sophistication achieved by the Roman army medical services in the first three centuries of the Christian era was not reached again in Europe until the seventeenth or eighteenth century".

3.9 Religion and Burial Practices

Religion during the Romano-British period went through various stages of development. For example, in the early stages of the Roman occupation, Roman religion was polytheist. For example, Olympian and classical gods were introduced into Britain by the Roman army, officials and trades form around the empire (Bennett, 2001). During the first and second centuries AD the predominant religions were both Celtic and Romano Celtic religion. By AD 55 Colchester was the centre for the Imperial cult, an altar was built there, and public sacrifice, not congregational worship, was practiced (Henig, 1989; King, 1991; Bennett, 2001).During and after the late second century AD, there was an absence of a unifying belief, and therefore other cults became significant (Henig, 1989; King, 1991; Bennett, 2001). People believed in different natural and supernatural forces that were directed by gods, and affected their everyday life through dreams, visions and actions (Bennett, 2001; Nutton, 2004). Religious beliefs were usually directed to men of high status, and mystery cults which involved orgiastic and hysterical rituals were practiced by them (Bennett, 2001).

Religion was perhaps one of the reasons for the development of towns during the Romano-British period. People from different professions (local landowners, army officers, etc) and social status may have been attracted to certain areas of the Roman Empire for the sole reason of religion (Henig, 1989; Bennett, 2001). Temples were not necessarily the only sacred places; as gods could exist in an open space or an enclosed space such as a circular timber house other than a temple. For example, a room or natural spaces such as a spring (for example, the hot springs in Bath, Avon) could have been used as a place of worship (Henig, 1989; Bennett, 2001). If the sacred spring had an unusual colour, taste and smell, it probably had several deities (Nutton, 2004:274). Some of these religious sites were in use during the Iron Age (Bennett, 2001). Later on during the Roman occupation stone buildings were constructed to replace the timber shrines (Bennett, 2001). Temples could have provided a religious, social, political and economic attraction to people all around Roman Britain (Hingley, 1989: 92).

The discovery of several shrines in Romano-British houses and temples in Britain has provided a picture of the religious beliefs that were prominent during this period, as well as the notion that general peace and prosperity was present (Nutton, 2004). Romans believed in more than one god, for example, Mars, Asclepius, Jupiter, Juno, Isis, Diana, Hercules, Minerva (goddess of wisdom and protector of Rome), Mithras (god of light and truth and also well known for its qualities of courage and loyalty) and Serapis (Egyptian god of the underworld) (Henig, 1989; Bennett, 2001), and some of these gods had local powers in one region or area, but others had universal powers, such as Apollo (Nutton, 2004). For example, an altar dedicated to the cult of Isis and a statue of the god Attis have been found n London (Henig, 1989). According to Nutton (2004:273) in the world of the Roman Empire, "gods were everywhere". Many of these deities were taken from beliefs and customs from all over the empire (Persia, Egypt, etc). Each house also had a household god who took care of the family in general. Examples of Roman temples in Britain can be seen in Colchester (Temple of Divus Claudius) and in Chichester (Temple of Neptune and Minerva) (Henig, 1989).

Interesting religious rituals or ceremonies occurred during the Romano-British period with raven, goat, chicken bones, and skulls of horses, cattle, sheep and dogs being deposited in wells, and sometimes these remains were associated or buried with human infant burials (Grant, 1989:145). It is possible that many of these animals were sacrificial victims and were associated with the Roman god Mercury, god of flocks and herbs as well as the god of trade, commerce and of prosperity (Webster, 1986; Grant, 1989; Henig, 1989; Bennett, 2001). This is why dedicatory tablets to Mercury are usually found in commercial centres such as London; on the other hand, dedications to Mars, the god of war, are frequently found in Roman military areas of Britain (Bennett, 2001). Cult shrines to Mithras are also found in commercial and military centres, this is as the Mithras cult was restricted to men only, and it offered eternal life and lightness after death. The cult involved initiation rituals, commitment, courage and honesty which attracted military officials and wealthy traders (Bennett, 2001)

A sacrificial altar has been found in the temple of Sulis Minerva at Bath, (Henig, 1989; Bennett, 2001). In the same temple inscribed lead tablets have also been found, with invocations to the god Sulis to recover stolen property, and to punish malefactors. Similar kind of tablets (*defixiones*: curse tablets) have been found in other areas of Britain, For example in the river Tas at Caistor St Edmund and in the Thames at London, in this case the tablets are addressed to Neptune (Henig, 1989:223-224). Coins and jewellery (bracelets, rings and brooches) were also given as offerings to the gods, and much of the jewellery were intentionally broken (killing of the object) as a sacrificial object to the gods. It has also been suggested that this ritual indicates the breaking of a matrimonial tie or simply the establishment of a new tie (Webster, 1986). It is believed that these valuable items given as offerings were used and sold by the keepers of the temple to support the cults and the repair of the temple and buildings (Henig, 1989).

During the reign of the emperor Constantine the Great (AD 306-337), both Roman and British religions and rituals were mixed (Webster, 1986; Bennett, 2001; Nutton, 2004). There was, for example, a Roman goddess of healing called Sulis Minerva and a British god of healing by the name of Nodens (Webster, 1986; Bennett, 2001), and the British gods Cunomaglos and Rosmerta were equated with Apollo (Bennett, 2001). British tribesmen usually would find a native equivalent for the Roman gods or vice versa; once Roman officials learnt the power and influence of a local deity, a classical counterpart would be found for it (Webster, 1986; Henig, 1989; Nutton, 2004). Bennett (2001:49) calls this mix of beliefs "the practice of syncretism, or fusion", where knowledge of the different gods were spread among the people.

Great consideration was given to the burials of Romano-British individuals. During the 1st and 2nd centuries AD, cremation was the procedure used to dispose the dead. The ashes obtained through the cremation, and sometimes small pieces of bone, were collected and put in containers which could be made of glass, pottery, metal, wood, leather or fabric (Henig, 1989; Bennett, 2001). Usually, offerings such as jewellery, food, toys, and clothes were placed alongside of the cremation to accompany the body to the afterlife. Around AD 150 the way of disposing of a body started to change from cremation to inhumation, and from the fourth century AD inhumation was the usual burial rite performed (Welch, 1992). Conheeney (2000a, 2000b) suggests that the change from cremation to inhumation may have been a matter of fashion and tradition instead of a religius belief.

Those people that could afford it were buried in a coffin made of wood, stone or lead. The placement of grave goods also continued. The rich also had a tombstone placed at their burial site. On them, inscriptions in Latin give praise to the dead and in some cases moving dedications were provided. For example, Bennett (2001:60) gives an example of an inscription of a tombstone where "demonstrations of family love and care" is given. The message from Quintus Corellius Fortis of York: 'For Corellia Optata, aged thirteen…I the father of a virtuous daughter, the victim of unfair hope, pitiably bewail her final end.'

3.9.1 Christianity during the Romano-British Period

During the third century AD Christianity became the religion of the Roman Empire and it was thus established in Britain. The Church offered organization and victory over barbarism and it also received imperial resources and favours (Thomas, 1981; Henig, 1989; Nutton, 2004). Christianity also offered spiritual salvation and immortality for everybody, no matter their original faith, sex or social class; this is the reason it became very popular, and earlier Christians were peasants from rural areas (Bennett, 2001; Nutton, 2004). The belief in Jesus also brought physical (body) healing, this idea being introduced through the miracles performed by Jesus (healing lepers, the blind and the paralytic) (Nutton, 2004). The charitable work of feeding the hungry and caring for the sick and old performed by the Christian church also attracted people to Christianity.

Even though Christianity denied the divinity and power of the Roman gods, by this time the Romans and British were mostly Christians. On the other hand, some of the traditional forms of religions persisted; pagan healing shrines continued to be built around the country, for example the shrine of Nodens at Lydney in Gloucestershire (Casey and Hoffmann, 1999)."Pagan practices did not die out" (Henig, 1989:232). Henig (1989:230) gives examples of this time period where "beliefs and expectations were mixed"; both a lead tablet from Bath and a gold ring from Silchester have been found containing inscriptions saying "Sulis or Christ- which would work?" and "Does he live in the Christian God, or some other". Nutton (2004:304) explains that "the replacement of pagan healing gods for Christian God was a gradual process".

Several Christian chapels have also been found in some Romano-British houses. The "house church" is the earliest evidence of the christianity in Britain, an example being observed at Lullingstone, Kent where wall paintings show biblical scenes. Churches were also built in Romano-British cemeteries where Christians were buried, as at the site of Colchester, Essex (Pinter-Bellows, 1993). Henig (1989: 228) mentions that "all dead Christians were important, but cult was offered to martyrs and confessors." By the 4th century AD, the Church became very powerful and established. Intra-mural churches were the seat of bishops, an example of this kind of church being found in Richborough, Kent where the font of a baptistery was located (Henig, 1989). Bishops became very influential in politics and social life (Nutton, 2004).

The resurrection of the dead is a very important doctrine of christianity, the belief being that the dead will arise to face the day of judgement and find their way to paradise (Henig, 1989; Bennett, 2001). The dead were extremely significant for Christianity, and therefore during the Romano-British period a lot of care was taken to bury the dead. Christian burials usually were oriented with the head to the West and in some cases the body was buried in a casket and covered by gypsum to be preserved for eternity. Evidence of this has been found in the Roman cemetery of Poundbury, Dorset (Farwell and Molleson, 1993) and at Butt Road, Colchester (Crummy *et al.*, 1993). Christianity also involved rituals that were practiced during a persons life, for example, baptism and rebirth which could be obtained only by believing in Christ and following his laws (Bennett, 2001).

3.10 The End of the Roman Empire

The end of the Roman Empire in Britain came almost 400 years (including Julius Caesar's invasion) after their first arrival. The Roman army was needed in other parts of the empire where 'barbarians' were attacking and invading. Linguistic, cultural, military and political factors helped to break the unity of the Roman Empire (Nutton, 2004). Vandals from Germany established kingdoms in Gaul and Spain. Visigoths from southern Europe also instituted their kingdom in Spain. Franks and Burgundians from France and Germany invaded Gaul and Ostrogoths from Eastern Europe conquered Italy (Williams, 1994a; Steele, 2001). Rome lost political importance, Gaul was cut off from Rome, and therefore no further support was given to Britain. The quality of life in rural areas started to decline and the strong economy, good diet, and medical surgical care deteriorated (Scull, 1992; Steele, 2001; Nutton, 2004). During the 360 years of Roman rule, many forts were built to stop invading people. However, this did not stop the newcomers establishing themselves in southern and eastern Britain. Britain and its population of Romano-British people were overwhelmed in subsequent years by people who came from Denmark and Germany. Saxons, Jutes and Angles colonized much of southern Britain in the 5th and 6th centuries (Drewett *et al.*, 1988; Williams, 1994a; Steele, 2001). In the next chapter the Early Medieval period is introduced.

Chapter 4: Early Medieval Period (AD 450 – AD 1066)

4.1 Introduction

The end of the Romano-British period in Britain, due to the reduction and withdrawal of the Roman army, affected Britain economically and socially with standards of living declining (Drewett *et al.*, 1988; Hills, 1999). This marks the beginning of the Early Medieval period. The Early Medieval period in Britain extended for six centuries: from around AD 450 to around AD 1066 and the Norman Conquest (Figure 4.1 illustrates England and Wales at different stages of the Early Medieval period). This period is mainly characterized by the immigration of people from Europe and the developing of kingdoms and regions, especially in the south and east of England (Drewett *et al.*, 1988; Welch, 1992; Williams, 1996; Hunter and Ralston, 1999; Nutton, 2004). Immigrants came mainly from the lowlands of northern Germany, southern Scandinavia and Denmark and competed for territory and power (Simmons, 2001). Many of the Britons of the south and east of England moved or were displaced northwards and westwards (Southwest of England, Wales and Scotland) by new settlers (Angles, Saxons, Jutes, Frisians and Franks). Other Britons stayed and assimilated new ideas brought to Britain and viceversa. However, more importantly, many Britons were enslaved by newcomers and were used for manual labour on farms. Years after conquering the coastal areas of Britain, the new settlers also moved inland following Roman roads as well as the rivers valleys, creeks, streams and brooks. In other words, their settlement pattern followed a coastal and riverine distribution (Drewett *et al.*, 1988). For example, there are a high number of Early Medieval settlements (Thorpe, Egham, Shepperton Green, Stanwell and Staines) along the fertile soil of the Thames river valley (Drewett *et al.*, 1988: 294; Hills, 1999).

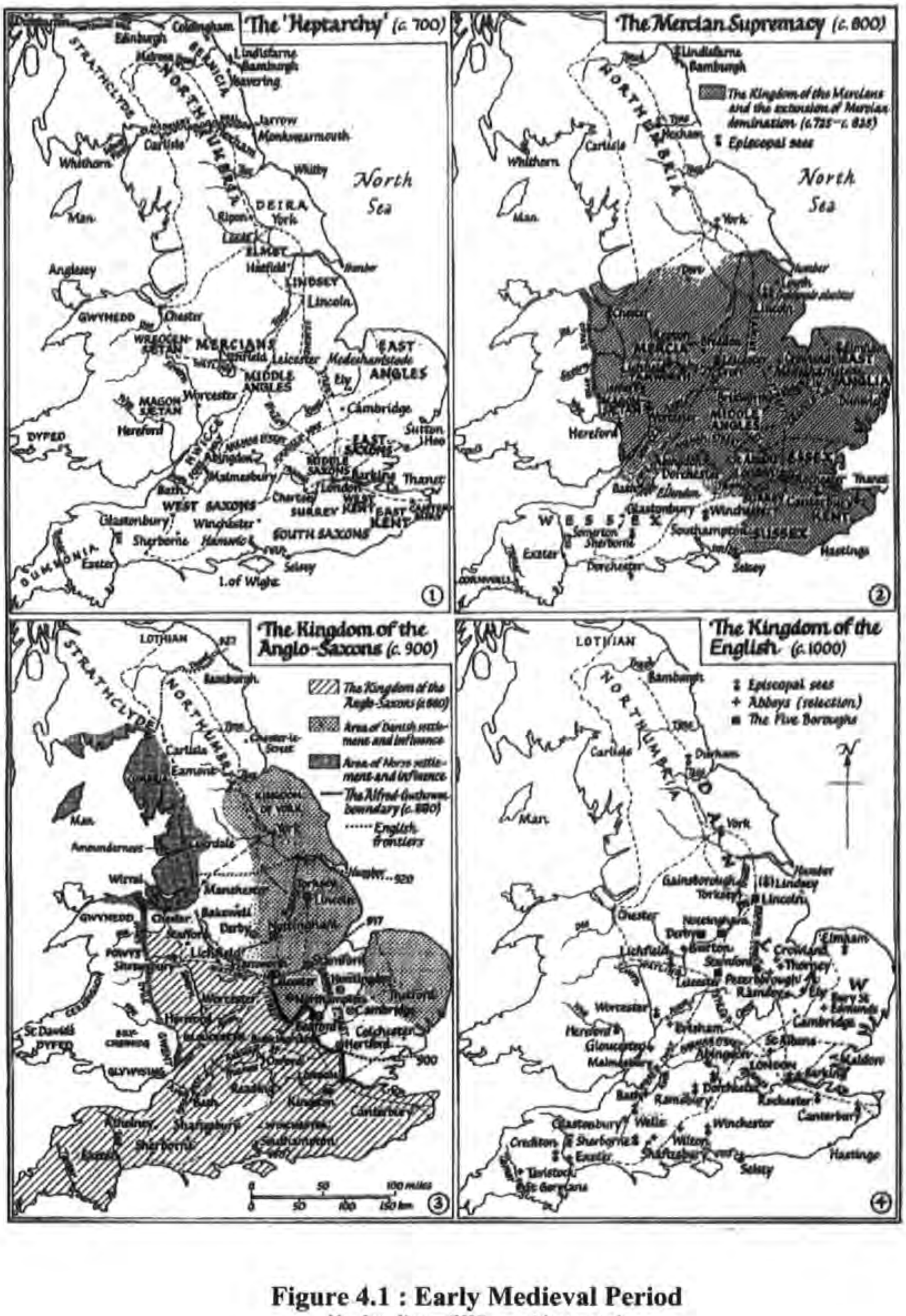


Figure 4.1 : Early Medieval Period
Map from Keynes (2006) www.trin.cam.ac.uk

Overpopulation, a change in climate, flooding (sea levels rise) and the need for new resources during the early years of these period, prompted the search for new land in England (Drewett *et al.*, 1988; Welch, 1992; Hills, 1999). The Angles established themselves in East Anglia, the Midlands and Northumbria (Williams, 1996:6). The

Jutes established themselves in Kent, Hampshire and the Isle of Wight. The kingdoms created by the Saxons were: Sussex (the south Saxons), Wessex (West Saxons), Essex (East Saxon) and Middlesex (Middle Saxons). By around AD 600, other kingdoms had been formed around England: the kingdoms of Mercia, Kent, Northumbria, and East Anglia (Williams, 1996:12). Battles and land disputes were fought between these kingdoms to gain superiority over other kingdoms, as can be seen with the land of Middlesex disputed between the West Saxons, the East Saxons and the Mercians. And at the end of the dispute, the land was divided between the kingdoms (Drewett *et al.*, 1988; Hills, 1999). "At the time of the Augustinian mission (AD 596) the Anglo-Saxons controlled the whole of England from Kent to East Dorset and from the East Coast to the lower Severn, Staffordshire and Derbyshire, most of Yorkshire and part of Northumberland and Durham" Wilson (2003: 29). The kingdoms of Anglo-Saxon England were not composed of homogeneous groups of people, but were a combination of many different peoples who had been mixed up on the Continent before the migration (Drewett *et al*, 1988).

It appears that the population of Britain declined after the Roman departure (Drewett *et al.*, 1988; Hills, 1999). Actual numbers are difficult to calculate because the lack of reliable evidence of population numbers in the past. But it appears that during the Romano-British period there were more than five million individuals living in Britain and during the Early Medieval period less than three million were present (Dyer, 2000; Simmons, 2001), then more than 40% decrease in population can be seen. Towns that were established during the Romano-British period were drastically reduced in size as their population moved from urban to rural areas and the economy and commercial support that existed during the Romano-British period declined (Drewett *et al.*, 1988; Hills, 1999; Dyer, 2000). However, all this changed by the early ninth century AD, when more people from the continent arrived. With this arrival, improvement in trade, economy and lifestyle occurred. Around three million people lived in Britain at this time (Williamson, 2003). There is evidence of the growth of population in settlements because of the expansion in sizes of the settlements (Drewett *et al.*, 1988).

The presence and dominance of Anglo-Saxon settlers in the south and east of Britain is suggested by the number of place names related to the different Germanic language used. For example, the Anglo-Saxon word 'stead / sted' which means 'place' have been used in 'Stanstead' and the word 'wick/wich' which means 'produce of a farm' can be found in the place names 'Greenwich' and 'Harwich' (Gelling, 1978; Cameron, 1996; Gelling and Cole, 2000). Other Anglo-Saxon words used in place names are: ford (river crossing), bury (fortified area), port (market town), barrow (wood) and ham (homestead) (Reaney, 1960; Cameron, 1996). These languages were used in England from the 5th century to the 12th century and with the introduction of Christianity, the Latin language was re- introduced (Gelling and Cole, 2000).

On the other hand, Oppenheimer (2006: 375 and 379) explains that genetic analysis (a phylogeographic method, which uses individual genes and their position on a gene tree to build up the origins and movements of a particular gene) has proved that the immigration of Anglo-Saxons to Britain was not as extensive as previously thought or suggested. Most of the gene pool that the English possess comes from a Basque foundation whose people immigrated to Britain around 15,000 years ago and the Anglo-Saxons only contribute about 5% of the modern genetic makeup and 15% in some areas of the south east of England. A total replacement of the indigenous population of Britain during the Anglo-Saxon invasion is unlikely and both male and female genetic records shows that the main gene line found in England came between 15,000 and 7,500 years ago (Oppenheimer, 2006).

Welch (1992:11) suggests that it is possible that many of the newcomers married local British women. This factor consolidated the relationship between Britain and the Continent; in addition there is a possibility that other Anglo-Saxon males brought their families with them sometime after they settled. As mentioned, it is possible that some displacement of people occurred during the Anglo-Saxon migration but it was also likely that integration, acceptance and continuity was possible between locals and the newcomers. Cooperation between them existed and new settlements were created (Scull, 1992; Hills, 1999). In addition, Drewett *et al.* (1988: 251) describes that "hand-made grass –tempered pottery found (used) in the Early Anglo-Saxon period in Britain has a wide distribution in the areas occupied by Germanic settlers". This also supports the idea of integration and continuation in the early years of the Early Medieval period, as goods produced in Britain were also used by the new settlers.

The dynamic nature of early medieval society can be observed from the migration period to the creation of kingdoms and their expansion. For example, around AD 780, Offa, king of Mercia, ruled the south-east kingdoms of Sussex, Wessex and Kent, maintaining important trade with Frankish areas of France, Netherlands and Belgium on the continent. Settlements were established and expanded in the south and east of England. During this time, silver coins, portraying Offa, were used in the kingdom. Many battles were fought between Offa's army and other Saxons kings (for example, the battle of Otford). Offa died in AD 796 leaving the kingdom to Ecgfrith (his son). However, he did not rule for long as he died the same year. Coenwulf then became king of Mercia in AD 796 (Drewett *et al.*, 1988). The kingdoms of Kent, Wessex and Mercia were formed in the first century and a half of the English settlement (Bassett, 1989a). To create kingdoms, there was a translation of leaders and chiefs of tribes into kings, but is also involved the takeover, by outside groups, of an existing territory (Bassett, 1989b:23). Kingdoms vary in sizes and importance according to population size, settlement, trade system and military power (Bassett, 1989b; Charles-Edwards, 1989). Burial assemblages of the time also show the dynamic nature of the period, for instance, grave goods can be found on some burials but during the conversion period (c. AD 600-850) the amount of grave goods declined (Geake, 1997). Importantly, the Christian Church also brought important changes to the kingship system that existed before Christianity (Bassett, 1989b). Many defence structures were built during this time. These defensive systems consisted of earthworks (banks and ditches) constructed alongside rivers, roads and boundary lines; examples of these can be found at Ashstead, Surrey and at Bexley, Kent (Drewett *et al.*, 1988).

In AD 787 Vikings, who were great navigators, landed in England. The Vikings or "north-men" came from Scandinavia (Denmark, Norway and Sweden). It is believed that they came to England in search of land to settle, work and live because these were scarce where they came from. They needed new land to farm, fish and establish trading ports (Richards, 1999). Roberts and Cox (2003: 210) suggest that it is possible that the "people that were in England at this time did not suffer the wreak devastation that was thought before", it was a continuous process of migration. This statement probably applies to the early stages of the Viking migration, but, around AD 865 organized Vikings raids started. Monastic treasures were taken and many people were killed. Both economy and trade suffered and for approximately one hundred years, war and instability were common between the English and the Vikings. For example, the battles of Reading, Ashdown, Basing and Merton were fought during this period. Vikings took power over East Anglia, part of Mercia (Danish Mercia) and York (Jorvik, important centre of the Danelaw: area under Danish Viking control) (Richards, 1999; Hadley, 2000) and new Scandinavian words and language (Old Norse) were introduced in the existing old English language (Gelling, 1978; Gelling and Cole, 2000).

Wessex was a strong Anglo-Saxon kingdom, led by Alfred the Great, who was king from AD 871 to 899 (Pollard, 2005). Alfred developed a strong army and navy to fight the Vikings. Fortified areas were built which served as forts but also as settlements and commercial centres (Drewett *et al.*, 1988; Richards, 1999). Thanks to Alfred and his army, the Vikings were defeated, and unity started to flourish between other kingdoms in England; both Vikings and Anglo-Saxons lived together, certain amounts of knowledge were passed between them and economy and trade also increased (Hadley, 2000; Pollard, 2005). It is important to mention that in subsequent years from AD 980 to 1014 new Vikings raiders arrived from Norway, Denmark and Normandy and around AD 1016 Cnut (a Dane) invaded England and was proclaimed king of England, Norway and Denmark. Cnut supported trade between these countries which improved the growth of the urban economy, such as the craft industries, but his reign ended in AD 1035 when he died (Richards, 1999). At this point, many Danes moved around England and settled while others returned to Scandinavia and never came back to Britain (Hadley, 2000).

In AD 1066 after the death of Edward the Confessor; William of Normandy invaded England and defeated Harold of Wessex in the battle of Hastings (Williams, 1996:42).Therefore, the church, administration and laws began to be influenced by Norman rule. The Norman Conquest marks the end of the Early Medieval period and the beginning of Late Medieval period.

4.2 General Environment and Climate during the Early Medieval Period

In the fourth and fifth century AD, sea levels across the English Channel began to rise, badly affecting the coasts of north-western Europe, Germany and Frisia (Drewett *et al.*, 1988). In Britain, during this period, English climate was colder and wetter than that of the Romano-British period, and it continued in this way until about AD 700. Trees and dense woodlands (elm, oak, birch, etc) were a common sight (Hooke, 1998; Simmons, 2001; Rackham, 1993; Williamson, 2003) but marshland could also be found (Hooke, 1998; Rackham, 1993). Drewett (1988: 292) states that "forests extended over parts of the fertile coastal fringes and over areas of the North and South Downs". In addition, it is important to mention that around the fifth century AD the Kent area of England had very fertile soil. The presence of many Roman farms and villas were close to this location which served as an indication to the new settlers that the area was worthy of exploitation as farmlands (Drewett *et al.*, 1988; Hooke, 1998). However, during the late 10th and 11th centuries AD, overpopulation of the area contributed to the disappearance of many areas of woodland as people needed wood for the construction of houses, new towns, tools and as fuel. Agriculture and pasture also moved from open fields to woodland areas, increasing the destruction of woodland (Dyer, 2000; Williamson, 2003).

4.3 Living Environment: The Rural Setting

During the Early Medieval period, the countryside saw an increase in population. With the lack of Roman support, many people decided to leave the towns and move to rural areas (Drewett *et al.*, 1988). The newcomers encountered many areas of cultivation, some which were active, and others which had been abandoned (Drewett *et al.*, 1988: 267). Some continuity probably occurred with respect to the use of the farmland. Rural houses were much like houses in the Iron Age being made of wood, wattle and daub walls and roofed in thatch or thin timber tiles. Usually these buildings and structures followed a rectangular plan, contrary to the round structures seen before. They varied in size with timber posts, wooden walls or wattle walls made of stakes interwoven with branches which separated one or two rooms within the structure (James *et al.*, 1984; Powlesland, 1997). People would have lived, slept and eaten in the larger room of the house. This main room would have been the one where the central fire was located (Truman, 1950; Harrison, 1971; Welch, 1992). Sunken floored huts also became popular with a central fire or hearth located in the centre of the main room providing the heat and means of cooking (Truman, 1950; Welch, 1992; Powlesland, 1997). Placing the hearth in the centre of the room prevented fires occurring against wall timbers (Welch, 1992; Powlesland, 1997). Usually, no windows were built and no systems to let the smoke out were present either. Floors could be made of just beaten earth or covered by wooden boards (James *et al.*, 1984; Welch, 1992; Williams, 1996; Powlesland, 1997). No or little furniture was used as eating and sleeping was mainly done on the floor. If tables or benches were present then these items were also used for sleeping (Truman, 1950; Harrison, 1971). The sloping angle of the roofs provided an efficient way to manage rainwater (James *et al.*, 1984). Frequently, animals lived in houses along with humans.

Groups of three or four families formed the initial settlements or shires. The work of the land was then shared by these families or the unit that cultivated, harvested and consumed the products of the land (Drewett *et al.*, 1988; Simmons, 2001). In addition to this kind of settlement, dispersed or isolated farms may have also existed. Sometimes, settlements, households and buildings were separated from other settlements by wooden fences that marked the territory owned by a group of people, but they also provided protection against wild animals and enemies (James *et al.*, 1984; Powlesland, 1997). Farm animals also lived within the fence enclosures (horses, oxen, dogs, sheep, goats, pigs and cattle). Small enclosures for vegetables were also built (Welch, 1992). If other buildings were part of a single settlement or farm unit, they probably were used for storage and work areas. Shards of pottery, tools, loom-weights, spindle-whorls and animal bones found at these sites support this idea (James *et al.*, 1984). During the years, settlements went through several phases of construction and reconstruction (James *et al.*, 1984; Powlesland, 1997).

4.4 Living Environment: The Urban Setting

The population of towns declined during the early years of the Early Medieval period. However, settlements and shires grew as more people arrived from the continent and other areas of Britain. Villages were formed which then became towns and kingdoms. These towns became administrative, economic, defence and employment centres (James *et al.*, 1984). Some of the urban settlements or towns consisted of a mix of rectangular timber buildings compounds built in a similar way to the buildings of the rural environment, but a hall to keep animals or food was also added to some of the structures (James *et al.*, 1984; Powlesland, 1997). The sizes of the building varied, but usually there was a large rectangular building with opposing doors at each side. Smaller buildings were also part of the complex (Powlesland, 1997). At Staunch Meadow, Brandon, Suffolk, rectangular structures with doors opposite each other were excavated. The building sizes ranged from 4.2m X 2.8m to 15.5m X 7.5m and the floors consisted of clay and chalk with flint and clay hearths (Carr *et al.*, 1988). Benches and important furniture were placed around the central fire (Truman, 1950; Harrison, 1971). In the main hall all daily activities were performed. It is possible that in some buildings, a separate sleeping room was built, but it was only used by the master of the house (Harrison, 1971).

Many lands and villas utilized for agriculture and settlement during the Romano-British period were used by the Early Medieval populations. Early Anglo-Saxons established some of their villages close to Roman fields and Roman centres. For example, the Cliffe district in Kent shows evidence of Roman-Saxon continuity (Applebaum, 1958; Welch, 1992). Evidence of Roman fields and centres could have been identified by surveying the lands close to rivers and recognizing Roman roads and buildings (James *et al.*, 1984; Powlesland, 1997). The increase in population and the expansion of land promoted the development of rights for the user of the land and the demarcation of boundaries between settlements; this permitted some control on the exploitation of the land (Drewett *et al.*, 1988).

Important fortified centres, possibly constructed for protection against enemies (the Danish, raiders and other kingdoms), were built during the reign of Alfred the Great (AD 871 to 899). These centres were transformed into important towns (Derby, Leicester, Nottingham, Stamford and Lincoln) where people lived; markets were established and trade improved (Hadley, 2000). The growth of urban centres encouraged the demand for food, fuel and raw materials for building, crafts and trade (Ayers, 2000). It is important to note that around these urban centres many cemeteries were built, some for the rich and others for the poorer people (Drewett *et al.*, 1988). A drawback of these towns was that they became overpopulated, as people from around the country decided to live in them, therefore crime, pollution and disease became part of urban living (Hadley, 2000; Roberts and Cox, 2003).

4.5 Early Medieval Trade

Despite all the turmoil encountered during the Early Medieval period, trade was well established in towns. "The towns were not only markets for agricultural produce from the surrounding countryside; they served also as markets for goods from abroad" (Wilson, 1972). It is clear that even from around AD 560 the people from the kingdom of Kent and other areas of Britain were trading with people of Europe (Kelly, 1992). However, the initial trade was not directed to the general population, but for the elite. The initial reason for trade was to obtain objects from abroad which were a sign of high status; royal officials administered and kept control of the trade that was present (Drewett *et al.*, 1988). The import of goods, such as high quality jewellery and pottery, which was exchanged, indicates the importance and significance of the merchandise from continental Europe (Drewett *et al.*, 1988). Coins from France have been found at archaeological sites in England, and artefacts such as pottery vessels, and brooches from regions of north Germany, south Scandinavia, Turkey and Egypt were also common, especially in high status homes (Welch, 1992). For example, Welch (1992:11) mentions that "fifth century pots with standing-arch designs...and pots with simple rectilinear decoration from Germany can be matched to those found in eastern and southern England". Franks maintained their connections with Northern France and the Jutes with Jutland. Other artefacts that establish a link between the Continent and the south east of England include: beads, glassware (jars, cups, beakers, bottles, etc), iron and salt, some of which seems to have been exported from the south of Scandinavia to Kent (Kelly, 1992). Heyworth (1994:79) indicates that "there are some variations in the levels of phosphorus, potassium, and calcium in the beads. This indicates variations in the raw material used to make glass, which reflects multiple sources (Northern Europe) for the beads".

Food, wine, oil, etc was supplied by farms to trading settlements in England. The trading system between London and York was very important as many goods were exchanged across the country (Kelly, 1992; Welch, 1992). Initially, trade took place in coastal areas and ports, but by the sixth century trade expanded throughout the country, especially in areas close to London (Kelly, 1992). A factor that contributed to the expansion of trade during the early medieval period was the use of established Roman roads. Without doubt, during the Early Medieval period these roads served as a link between markets and villages within Britain (Kelly, 1992). In addition, because of the knowledge of navigation and the construction of boats and ships of the Anglo-Saxons and Vikings, the transport of merchandise by water also contributed to the establishment of the trade system during this period.

From AD 800 Vikings had established a trading system between Scandinavia and England; for example, furs were traded for slaves, along with clothing, pottery, wood, bone, ivory and metal artefacts and wine. In the south east, around AD 871 London's trade was one of the most important trade systems in England, but trading centres in Norwich and Cambridge were also working and maintaining trade with the continent. This strong trade system established by King Cnut with the continent helped England economically (Richards, 1999). Markets were established in important fortified centres which, in time, became relevant towns where organised trade and manufacturing of goods took place; jobs were offered and money was made. During the seventh century AD the first Early Medieval gold and silver coins were minted in London and Kent (Spufford, 1988); without a doubt this currency facilitated the development of trade which made the economy stronger. Mints also existed in the towns of Cambridge, Norwich, Ipswich and Thetford and later on (10^{th} to 11^{th} century AD) other mints were established at Bury St Edmund, Colchester, Sudbury and other areas (Spufford, 1988; Kelly, 1992; Hadley, 2000).

Pottery (decorated and undecorated) was one of the products traded in Britain during this period with several kinds of pottery being manufactured. There was hand-made but also wheel-turned pottery, which may have been glazed, pottery is usually associated with cremation graves and in these pots or urns the ashes of the deceased were put in and later buried along with grave goods (Evison and Hurst, 1974; McKinley, 1994). Pottery had several uses which varied from cooking to food storage (beans, dried meat, wheat, etc) and for liquids (wine, beer, ale, water, oil, etc). Many different types of pots include: large storage jars, pitchers, bottles, dishes, lamps, bowls, jugs, etc (Evison and Hurst, 1974).

Trade increased as rural settlements grew and became more established. The discovery of goods from the Mediterranean at British sites, does not imply that direct contact occurred between these places, but, it is evident that exchange occurred at some point (Drewett *et al.*, 1988).

4.6 Diet and Economy

During the early stages of the Early Medieval period, there was continuity in diet from the Romano-British period. The economy was mainly based on agriculture and the exploitation of any available resources. Daily food was basically baked bread, flour, cheese, milk, eggs and porridge, which could be eaten in any possible combination by mixing with water or milk (Hagen, 1992, 1995, 2006). Dairy products were available but not all the time (Hagen, 1992). Both rich and poor consumed similar foods but the difference was in the amount. For example, the rich had a more varied diet than the poor

(Hagen, 1992, 1995). Food was also used to pay rents or services to landlords (Hagen, 2006).

The agricultural economy from the Romano-British period to the Early Medieval period was very similar and animal size and the pattern of cut marks on animal bones from this period support this idea (King, 1991). However, the organized slaughter of animals that was characteristic during the Romano-British period declined and in some cases stopped (Grant, 1989). With the increase of population in urban centres it was necessary to expand the farmland as more production of food was needed (Hagen, 2006). While cattle and horses ate horse-bran made of leaves and plants of cereal crops (Grant, 1989), some of the areas of woodland and hills served as pastures for other livestock, for example the use acorns and mast from beech trees provided food for pigs (Drewett *et al.*, 1988:293).

(i) Meat

Sources of meat during the Early Medieval period came from cattle, deer, sheep, fish, molluscs, goats, pigs, fowl, dogs, horses and sometimes rabbit (Ayers, 2000). Based on animal remains found during this period; Welch (1992:39) notes that "cattle formed 48.3 per cent of domestic animals, followed by 23.7 percent sheep or goat, 12.7 percent horses, 11.1 percent pigs and 4.2 percent dogs". Cattle provided meat, milk, horn and hides. Beef, mutton, bacon, veal and venison, salted and dried, were prepared before winter (Hagen, 2006). During the Early Medieval period, sheep were killed very young, but later on adult sheep bones are more common, suggesting the importance of the wool industry (Grant, 1989; Hagen 1992). Pigs seemed to have declined in importance by the end of the Romano-British period, but became an important source of meat by the Early Medieval period (Grant, 1989; Hagen, 2006).

The rich had better access to meat than the poor, but some of the poor hunted wild animals for food. When compared with the Romano-British period, the consumption of wild animals (deer, boar, wild birds and rabbit) increased during the Early Medieval period, especially in more urban areas (Hagen, 2006). Deer was considered an important source of meat, especially for the rich, and started to be consumed in urban sites (Grant, 1989). Fish was also an important source of protein which increased in consumption when compared to the Romano-British period. Many marine remains and fish bones (pike, salmon, trout, cod, lobster, mussels, oysters, cockle, etc) have been found in coastal and inland Early Medieval sites (Grant, 1989; King, 1991; Brothwell and Brothwell, 1998; Hagen, 2006). The herring industry was also established during this period (Brothwell and Brothwell, 1998: 58). Grant (1989:144) suggests that "this intensified exploitation of wild animal resources can be viewed as a response to the problems of feeding an expanding population in a period when agricultural productivity was not similarly increasing".

(ii) Cereal, Vegetables and Fruits

The Early Medieval population had similar farming technology to the Romano-British period, and in many cases they re-used fields. As in the prehistoric and Romano-British periods, most fields were square and rectangular, facilitating the use of the plough. Few fruits and vegetables were cultivated and eaten when in season, indicating a possible vitamin C deficiency in winter (Hagen, 1992). When in season, vegetables farmed and consumed were onions, carrots, cucumbers, and cabbages. As mentioned before, sugars were obtained through the consumption of fruits and the main fruits available included strawberries, blackberries, apples and damsons (Hagen, 1992; 1995, 2006).

Cereals harvested during this period, included: wheat, which was the main crop, oats, rye, and barley (Hagen, 1992; 1995; Welch, 1992). Peas, lentils and beans were also consumed. Bread (or bread wheat) was the chief source of carbohydrates. Grain was coarsely ground, and particles from the quernstones used were probably incorporated into food. Meals were made from wheat, oats, beans and rye and this meal was made into thick porridge as well as being used for bread (Hagen, 1992; 1995). Flax and woad were also grown for cloth making and dyeing respectively (Wilson, 1972:73).

(iii) Salt, Herbs and Spices

Garlic was used to flavour some meals (Hagen, 1995, 2006) but both garlic (and honey) were also used for medicinal purposes (Roberts and Cox, 2003:215). Salt, on the other hand, was used to preserve meat (King, 1991) and was obtained from the coast of England. The coastline of Sussex (Pevensey Marsh and the Adur river Valley) and Kent (Romney Marsh) provided a good source of salt through heating sea water and evaporating it (Drewett *et al.*, 1988).

(iv) Honey and Sugar

Honey was the only additive sweetening agent available, but sugars (fructose) were obtained through fruits and vegetables, cane and beet sugar being completely unknown (Moore and Corbett, 1971). However, the date for the introduction of sugar cane in Europe is unknown but by the 8th century AD sugar cane was being cultivated in Spain (Brothwell and Brothwell 1998: 83). In Britain, cane sugar did not become available until early in the 13th century (Moore and Corbett, 1971; Hammond, 1993; Brothwell and Brothwell, 1998).

(v) Drinks

As many settlements and towns were located close to rivers, water was available to everyone. However, young individuals consumed milk from their mothers, and milk from cattle and sheep was consumed by children and adults. Beer and ale were the most popular drinks which, brewed from barley and found in alehouses (Hagen, 1992, 1995; 2006); remains of burnt germinated grains of barley and hops suggests brewing and malting (Ayers, 2000). Fermented drinks were also made from honey and wild fruits and some wine is known to have been imported (Welch, 1992; Brothwell and Brothwell, 1998). Brothwell and Brothwell (1998:166) describe the Saxons as notorious mead drinkers due to the lack of grape wine and that this grape wine was usually consumed more by the rich man than the peasant. Wine consumption then decreased during the Early Medieval period as only few could have access to it (Brothwell and Brothwell, 1998).

4.7 Occupation and Social Status

During this period, several industries were carried out in the South and East of England. Natural resources provided clay for pottery, stone for buildings and iron for metalworking (Drewett *et al.*, 1988). During the early years of this period, sheep dominated the wool economy (King, 1991:18) and were "one of the main exports of Anglo-Saxon England" (Wilson, 1972: 77). Many clay loom-weights, spindle-whorls and metal and bone needles had been found in remains of Early Medieval buildings (Drewett *et al.*, 1988; Welch, 1992). As trade was an important activity, many local goods were produced to be exchanged in trade centres and markets. For the king and royal officials it was very important that the exchange of products occurred as items of trade were symbols of power and status (Drewett *et al.*, 1988).

The metallurgy industry of the time (iron and copper) became very important and advanced. The industry was a mix of both Germanic and Anglo-Saxon ideas as can be seen in a description by Bayley (1991:115): "Crucibles (ceramic melting pots) are by far the most commonly found evidence of metalworking...All crucibles are reduced fired as metals must be melted under reducing conditions to prevent them from being oxidized and lost into a massive crucible slag". What this shows is that the technical skills and knowledge of the blacksmiths had become very advanced. "The skill of the Anglo-Saxon metalworker of the Christian period was renowned throughout Europe" (Wilson, 1972: 141). By the end of the 8th century chip-carved gilt bronze was replaced by carved silver (Wilson, 1972). Some of the metal goods produced during this period include: pectoral crosses, pins, bronze animal ornaments, brooches, gold rings and swords (Wilson, 1972; Jessup, 1974; Bayley, 1991).

From the 6th century AD there were kings represented by known Saxon leaders of a particular area. These important individuals or aristocrats lived in compound complexes (Powlesland, 1997). Thanes owned some of the king's lands which were farmed by churls (freemen) and slaves. The produce of these farms belonged to the king and some of the materials produced from farming were sold at forts (burhs) and markets. As can be seen, high status individuals had better access to certain types of foods (meats, vegetables, fruits and fish) than the poor while the poor also ate wild animals, fish and vegetables but in lesser quantities than the rich. The social classes were defined by the kind of property owned by the person, the payments that they received through rents, the weaponry that they owned and other economic activities (Drewett *et al.*, 1988; Roberts and Cox, 2003).

During life, thanes (members of the aristocracy), freemen (individuals that owned land and slaves) and other important members of the society carried their most important weapons (sword, spear, axe, and shields) as a symbol of high status and, at their death, many of these individuals were buried with grave goods. Between AD 535 and AD 560 most burials had expensive grave goods (Drewett *et al.*, 1988). An example of a pagan high status burial during this period (early seventh century AD) is the Saxon mound of Sutton Hoo in Woodbridge, Suffolk where a thirty meter long boat was discovered (Carver, 1998). It is believed that the burial belonged to one of the East Anglia kings (perhaps, King Raedwald). In the boat, several grave goods were found: Saxon jewellery, an iron stand, coins, silver artefacts, a helmet, a shield, a sceptre, a sword belt, an iron buckets, decorated drinking horns, wooden bottles and cups and pottery. Some of the rich artefacts and the fact that the burial was performed in a boat (ship burial) indicate links to Scandinavia (Hinton, 1993; Carver, 1998). Other burials from this period were interred with knives and pottery; these include women, juveniles and freemen burials. Some female graves were arranged with rich artefacts such as jewellery, brooches, claw-beakers, iron keys, etc (Drewett *et al.*, 1988). However, it is important to note that not all the burials, including male burials, had grave goods and the amount of artefacts placed in graves also varies enormously, especially when Christianity became the main religion.

Finally, another activity performed during this period can be illustrated by the several defensive systems of earthworks constructed around cities. It is assumed that to do this work, a large number of individuals (manual labour) possibly from near communities were used. A leader or group of leaders was needed to organise and supervise the building work (Drewett *et al.*, 1988).

4.8 Access to Health Care

By AD 650 "men of medicine" believed that the human body was divided anatomically and physiologically into three systems based on the brain, heart and liver. As observed in the Romano-British period, the health of these systems depended on the balance between the four humours, blood, yellow bile, black bile and phlegm (Nutton, 2004:292). The balance of the humours could be influenced by the age and diet of the person, and the season of the year and the environment could affect the equilibrium of the humours. To keep this balance correct, or to restore the balance, Early Medieval physicians used magic, amulets, curing stones, garlic, herbs, onions and blood-letting. Diagnosis was based primarily on visual inspection of patients, including the way the person behaved, skin and face appearances, the pulse rhythm and the colour and smell of the urine (Sournia, 1992; Nutton, 2004). In Europe, during this period, cane sugar was used more as a medicine rather than a sweetener; however, in England, honey was used a medicine (Brothwell and Brothwell, 1998) as it, and garlic, have antibacterial properties (Roberts and Cox, 2003:215).

Before the acceptance of Christianity, incantations, spells and charms were also used to treat ailments, just as in the Romano-British period. However, the creation of monasteries and abbeys by the church prompted the construction of infirmaries or small hospitals to provide charity and help the poor and disadvantaged. However, not only the poor were admitted. Patients included travellers, pilgrims, and also the rich (Sournia, 1992; Nutton, 2004). In these infirmaries some medical care took place such as the treatment of fractures, wounds and burns (Rhodes, 1985; Sournia, 1992). Some of the surgical procedures performed during this period involved trepanation and amputation. In addition, most medical texts were written in Latin, and therefore only educated members of society (e.g. clergy, monks and priests) of the society could understand or have access to the texts.

Anderson (2004:273) gives evidence for dental treatment during this period, therapy for toothache, periodontal disease, loose teeth, swelling and dental caries concentrated on "herbal remedies, charms and amulets", in addition operations were also performed (cleft lip) (Anderson, 2004). Herbal remedies consisted of pepper, plum tree leaf, coriander, apple tree bark, cucumber, radish, rosemary roots, cornflower, etc; also wine and vinegar were used.

4.9 Religion and Burial Practices

When the Anglo-Saxons arrived in England, they were pagans. From around AD 596, Christians and Augustinian Christian missionaries from Rome and Frankish Gaul (modern day Belgium, France, Germany and the Netherlands) were sent by Pope Gregory I and arrived at the Saxon kingdoms and settlements. They were sent to teach Christian doctrines, and convert the kings and their people to Christianity. It is possible that many individuals were already Christians by the time the missionaries arrived and the conversion to Christianity did not occur at the same time in all of Britain. Conversion first started in coastal towns and later moved inland. It was also evident in royal counts and spread from there to lower strata of society (Drewett *et al.*, 1988; Welch, 1992). Learning served the purpose of the church and it was also under its protection (Simmons, 2001; Nutton, 2004). These missionaries built churches, priories, abbeys and monasteries and brought with them administration, literacy, prayer, doctrines, writing, architecture, law codes, and coinage that were aspects and practices of the Roman Christian Church (Welch, 1992).

Many Anglo-Saxons and even Vikings combined pagan and Christian belief. Drewett *et al.* (1988: 310) mention that King Raedwald of East Anglia "continue(d) to worship pagan deities in his temple in which he also kept a Christian altar". Furthermore, objects or artefacts such as coins, food, weapons, tools, ornaments, etc were placed in graves to accompany the dead into the afterlife. "The introduction of Christianity did not put an end to the work of the pagan Anglo-Saxon jeweller" (Wilson, 1972: 139). However, later in the 7th and 8th centuries, Christianity became the main religion and influenced every aspect of Early Medieval society (Lucy, 2000). At this time, many pagan temples were converted into Christian churches and more churches and monasteries were built around the country. During the Viking invasion of England, many churches and monasteries were destroyed but during Cnut's reign several were rebuilt and new ones raised (Richards, 1999). Wilson (1972: 48) states that "the basic church of the Anglo-Saxon period consisted of a nave and a chancel covered with a pitched roof or roofs. In the chancel was the altar. Various ancillary elements were added to this basic pattern - porches, crypts, towers...galleries and even, in the latest period, transepts. Churches were built of wood, stone, brick, or a mixture of either two or three of these". An Early Medieval church with these characteristics is the church of St. Peter and Paul at Canterbury (Wilson, 1972). However, there were different kind of churches, which displayed a diverse plan and structure. In addition, churches were grouped as cathedrals, ordinary minsters, lesser churches and cemetery and churchyards. This division was perhaps based on the level of importance of a particular building (Drewett *et al.*, 1988).

In the south and east of England, Anglo-Saxons practiced cremation to dispose of the dead, but gradually inhumations were accepted. Many decorated and undecorated cremation pots or vessels where the ashes of the dead were placed have been linked to those found on the continent (Welch, 1992; Lucy, 2000), along with some grave goods.

Grave goods such as jewellery, knives, coins and weapons (spears, swords, shields, etc) are assumed to represent a pagan burial belonging to a wealthy individual (Wilson, 1972; Jessup, 1974; Lucy, 2000; MacGregor, 2000). Importantly, by the seventh century AD when Christianity was the main religion, inhumation was the leading form of burial and no grave goods exist (Welch, 1992; Lucy, 2000). Inhumation occurred in wooden coffins, underneath barrows or directly in the ground. Combinations of these disposal methods have also been encountered during the period (Lucy, 2000). Most of the time, the dead were buried in an extended position following an east- west orientation (Lucy, 2000), but, crouched burials are also found in this period (Lucy, 2000). As the placement of grave goods in burials declined, the number of grave markers (wooden posts and fences, mounds, etc) increased perhaps as an alternative way to display status (Drewett *et al.*, 1988: 285).

It is important to note that few religious manuscripts from this period still survive such as the Book of Durrow, the Lindisfarne Gospels, the Codex Amiatinus and the Echternach Gospels (Calkins, 1983). These historical records, of course, support the significance of the Christian church at the time, but they also give some idea of the art, symbolism and education that Christianity brought to Britain (Wilson, 1972; Calkins, 1983; Welch, 1992). Most illustrations depict passages from the Gospels.

4.10 The End of the Early Medieval Period

The Norman Conquest (AD 1066) marks the end of the Early Medieval period and the beginning of the Late Medieval period. At the beginning of the Late Medieval period there was continuity of ideas and culture from the Early Medieval, but, after some time, the Late Medieval period generated its own history. In the next chapter, the Late Medieval period is introduced.

Chapter 5: Late Medieval Period (AD 1066 – AD 1600)

5.1 Introduction

In AD1066 the Norman invasion occurred and Duke William of Normandy arrived in Sussex and in the battle of Hastings defeated Harold of Wessex, "the last Saxon king." (Williams, 1994b:6). The Normans centralized government, controlled England and Wales and attempted to expand their power and domination northwards and westwards (Simmons, 2001) (Figure 5.1 shows the Late Medieval period around AD 1399). Language changed throughout England with Latin and French becoming more influential as the church introduced new words (Gelling, 1978; Gelling and Cole, 2000). Many castles were built and usually towns and villages flourished around these castles. Castles were "the centre of local power" (Williams, 1994b:12): from there laws were established to control peasants and they were also used as prisons. Archaeological evidence from this period indicates "rich medieval deposits, surviving buildings, churches, industries, artefact assemblages and documents" (Ayers, 2000: 66). During this period many other conflicts occurred, for example the "Hundred Year War" and the "peasant's revolt" where thousands of people died or were injured (Dyer, 2000).

AD 1215 was the year of The Magna Carta, an agreement between King John and his rebellious subjects, where political rights were distributed between the king and his barons. The people obtained the right to protest against unfair treatments and laws and most importantly a group of barons could rule against any of the king's laws (Holt, 1992).

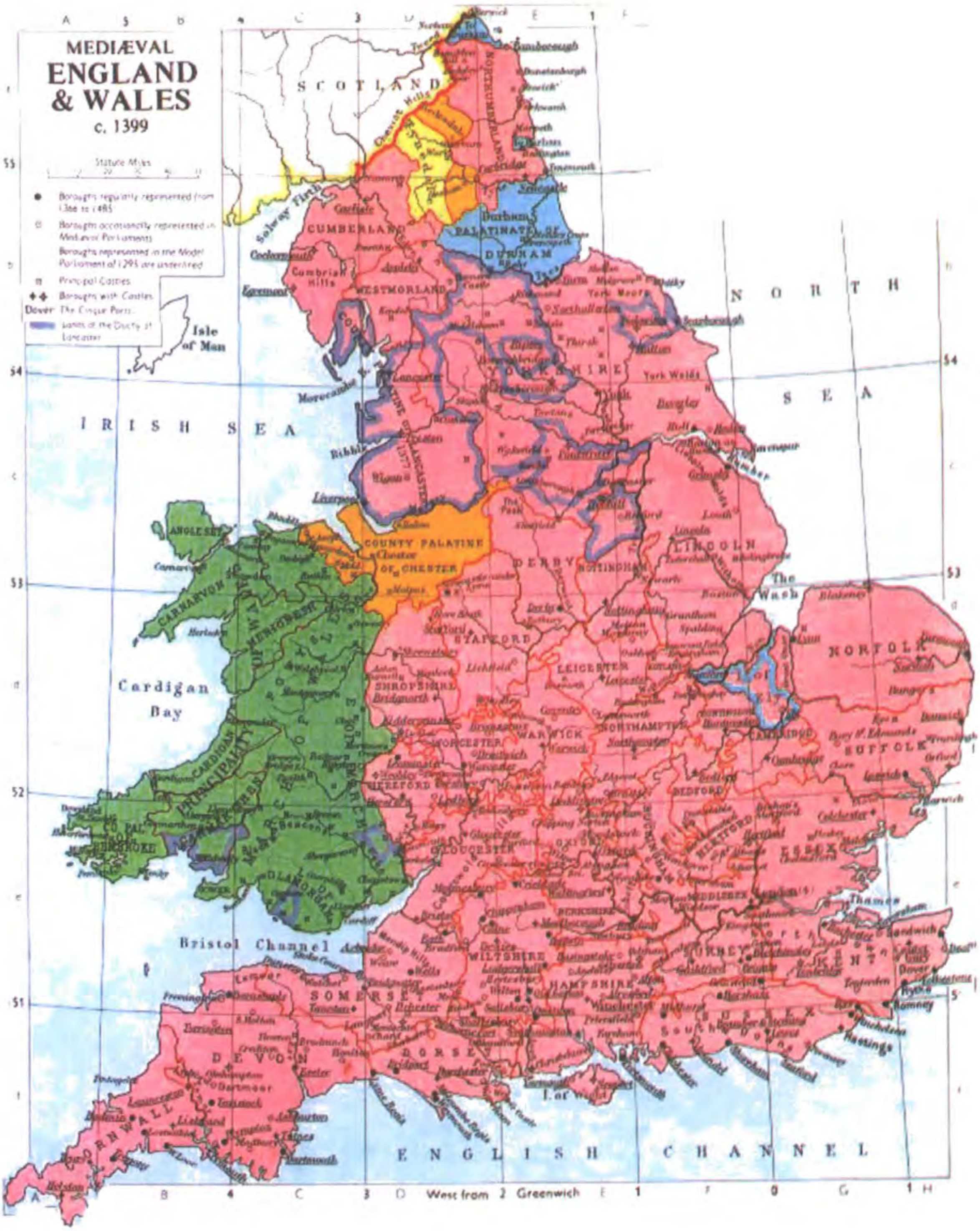


Figure 5.1: Map of the Late Medieval Period
Map from www.fordham.edu

Despite the lack of real evidence to calculate population numbers in the past, some numbers are presented by several researchers (e.g. Keene, 1989; Dyer, 2000; Simmons, 2001). During this period, England had a population of more than five million and London consolidated itself as an important trade centre. By AD 1300 London's population was approximately 80,000 to 100,000 people (Keene, 1989). Dyer (2000:13) indicates that "the population in England grew rapidly between AD 1086 and 1300, perhaps from about 2 to 5 or 6 million". On the contrary, between the mid-14th to the mid-15th century the population decreased drastically. Reasons for these changes could be attributed to migration to other parts of the country, the Black Death and famine (Dyer, 2000). However, by the 16th century the population grew enormously; for example, more than a million people lived outside castles; most of them were peasants and farmers while others lived in cities (Simmons, 2001). The necessity to expand cultivation to the woodlands encouraged an increase in land, corn and wheat prices (if they were available) (Kershaw, 1973). However, the use of poor and marginal soils affected food production and its quality as insufficient resources were available for the growing population (Kershaw, 1973:3). This situation was aggravated by the Great Famine of 1315.

The Great Famine of 1315- 1322 was an outcome of drastic changes in the weather system in Europe; both winters and summers were extremely cold and excessive rain fell (Lamb, 1995). Agriculture and farming were badly affected and products were in short supply. Wheat, barley, peas, root and green vegetables could not grow normally, consequently having an effect on all humans and animals. Disease, under-nutrition, crime, starvation and death prevailed all around England as there was not enough food to feed the already overpopulated country. The old and young died and a considerable decrease in population followed (Kershaw, 1973).

During the later half of the fourteenth century (1348/9), the Black Death (bubonic plague) that had affected central Asia and Europe (from 1348 to 1350), reached England killing thousands of people in a few months (Gottfried, 1985; Byrne, 2004). Simmons

(2001:15) suggests that "the Black Death reduced the population by perhaps one-third so that the level of the thirteenth century was not reached again until the seventeenth century". The disease followed the trade routes of Europe and England and it is believed that the points of entry of infected people, black rats and fleas occurred at the ports of Melcombe, Southampton, Plymouth and Bristol; as a result this situation strongly influenced society, both politically and economically (Gottfried, 1985; Dyer, 2000; Byrne, 2004). At the time people believed that the epidemic was caused by God, sin, astronomy or Jews (Gottfried, 1985). Sournia (1992: 157) illustrates that "mortality on such a grand scale...disturbed the equilibrium between towns and states, transformed social contacts by decimating families and creating new rich people, prompted the transfer of populations between towns, rural areas and regions spared or only slightly afflicted and also affected trading circuits". Several periods of famine occurred affecting the general health of the rich but mostly that of poor members of the society as there was a shortage of agricultural labour (Gottfried, 1985; Nutton, 2004).

However, after the Black Death, the need to revive social order took place as jobs and land were offered by the king and nobility, and the economy started to become stronger again with increases in wages, cheap food and the number of animals, not only for the wealthy but also for the poor (Gottfried, 1985; Keene, 1989). By AD 1400, towns became well populated with bureaucrats, merchants and peasants being attracted to jobs to improve of their general lifestyle (Gottfried, 1985). It is important to mention that between 1442 and 1459 several small epidemics also affected England (Gottfried, 1985; Byrne, 2004). These included plague, leprosy, smallpox, ergotism, measles and mumps which again produced a string of famines. These epidemics influenced the population at several levels, for example, economic, political and social.

The peasant's revolt of 1381 was an important event in the social history of Britain. Some time after the Hundred Year' War against France, new poll taxes, fines, rents and unfair laws were imposed in England by its government. People started to pay them, but soon people disagreed about paying taxes and they protested, thus the peasant's revolt started. Around Britain, these revolts occurred, (Dyer, 2000) and many people were killed.

The thirteenth century was affected by a growing interest in knowledge and learning seen throughout Europe. In England for example, universities and schools were established (for example, Oxford 1214 and Cambridge 1229) and these universities were closely monitored by the Church (Sournia, 1992).At the end of the fifteen century, the revival of art and learning following classical Renaissance models that began in Italy in the late Middle Ages spread into the rest of Europe, and influenced important changes as education, wealth, and security increased (Estep, 1986; Dyer, 2000).

5.2 General Environment and Climate during the Late Medieval Period

The general climate of this period is characterised by fluctuations, first with very warm weather from around AD 1000 to 1300 which was ideal for cultivation and farming and then, after AD 1300, with extremely cold winters and cool summers. Excessive rain produced devastating floods in coastal and inland areas. Consequently, the land moisture levels increased and agriculture and farming were badly affected (Kershaw, 1973; Lamb, 1995; Simmons, 2001). Rightly, Roberts and Cox (2003: 227) noted that "agricultural production, both arable and pasture, relies upon a combination of variables including the weather, soil, drainage, altitude and available technological and agricultural skills" and when all these factors are affected, economy and production subside. The whole Late Medieval period suffered from various climatic changes, some of very short duration but others more extended.

It is possible that during the late 10th and 11th centuries AD, overpopulation contributed to the disappearance of many areas of woodland. Basically, people needed wood for the construction of houses and settlements but also for fuel and industry. Agriculture and pasture moved from open fields to woodland areas, increasing the destruction of woodland (Rackham, 1993; Dyer, 2000; Williamson, 2003). This movement from open fields to woodland continued all through the 12th- 15th centuries (Rackham, 1993). All the climate and environmental changes contributed to the onset and spread of many health problems and epidemics (ergotism, leprosy, gangrene, convulsions, and other infectious diseases) and even death (Roberts and Cox, 2003:227).

5.3 Living Environment: The Rural Setting

Drewett *et al* (1988:339) indicates that in the "eleventh, twelfth and thirteenth century reorganization occurred from dispersed farmsteads to nuclear settlements". In other words, some but not all rural settlements comprising of a single small farm or hamlet became centralised villages made up of groups of manors, farms or hamlets owned by different people. This decision perhaps reflects the fact that the population was increasing and the necessity to work all fertile lands as one collective group. The concentration of the population in one place, for example a manor, also allowed barons and landowners easy control and management of the workers. As administration centres, villages also provided money through the payment of taxes and fines.

During this period, rural long houses were built of timber with thatch and sometimes slate or tile roofs. Houses varied in size but the need to use most of the land for agricultural and horticultural activities promoted the creation of small dwellings. Sometimes a barn and byre was also added, along with buildings for the storage of agriculture produce. Occasionally, stone provided the foundations of buildings which made the houses durable and stone walls were constructed to protect animals and gardens (Macfarlane, 1979). Some countryside villages had associated parishes and manor houses (Dyer, 2000). As in the Early Medieval period, many houses were built with few rooms and during the winter and other cool periods, animals were kept inside houses to protect against bad weather (Dyer, 2000). The great majority of dwellings "measured from 25ft (7.6m) to 50 ft (15.2m) in length, and from 12 to 16 ft (3.7-4.9m) in width" (Dyer 2000:155).

Simmons (2001:12) indicates that "the Norman aristocracy loved hunting and so appropriated great tracts of terrain as chases, warrens and forests, with the Royal Forests as the special preserve of the king". The special laws applying to the Forests often meant that they were unavailable for colonisation by ordinary people and so stayed as woodland or moors when neighbouring lands were cleared for agriculture; some still form the heart of uncultivated areas like the New Forest (Hampshire) or Epping Forest (north east Greater London and Essex) (Simmons, 2001). Around AD 1300 aristocracy tenants had 15 to 20 acre holdings of land (Dyer 2000: 7). During this period, pastoral activity increased and the expansion of grazing land allowed the raising of sheep and cattle.

5.4 Living Environment: The Urban Setting

As mentioned above, the population had increased, with most congregated around walled towns, manors and urban centres where castles, markets, churches, hospitals and jobs were available. Urban centres provided some kind of status and importance to people; houses were bigger in towns than in the country and had more space and rooms. From the 12th century AD onwards there was an expansion of town development and hundreds of timber and stone dwellings of several sizes were built. Floors consisted of pressed earth, wood and straw. Gardens were also added to the houses. In towns, shelter, food, markets and safety were found (Dyer, 2000). The expansion of urban centres encouraged the abandonment of small villages and rural lands. However, this also encouraged the establishment of pasture lands on abandoned villages and fields (Rackham, 1993).

As a consequence of the increase of population and a high concentration of people in urban centres, pollution and low levels of hygiene became a problem. Homes, streets, rivers, ponds, and areas of the landscape were contaminated by increasing waste and smoke created in homes, industry and markets (Hanawalt, 1993). This problem had an impact on the health of the people with sinusitis, conjunctivitis, parasite infestation and anaemia. "Archaeological evidence has shown that human faeces in urban cesspits contained large numbers of intestinal parasites, which would have been debilitating and could contribute to iron deficiency anaemia through blood loss" (Roberts and Cox 2003:234). Sullivan (2005:256) talks of the concentration of parasitic eggs ranging from "hundreds per gram of soil" and the overcrowding of houses facilitated the spread of disease (Hanawalt, 1993; Roberts and Cox, 2003). Contamination became so much of a problem that regulations for the disposal of waste were put into effect, but, there were too many polluters to follow and prosecute. Cities such as London and York were greatly affected by pollution (Hanawalt, 1993; Dyer, 2000).

In addition, during this period, the size of houses and dwellings were expanded, rooms also increased in size, more possessions were added and the central fireplace was moved to the walls; this cleared the centre of the room or hall for the placement of new furniture such as tables and chairs (Truman, 1950; Harrison, 1971; Dyer, 2000). The fireplace was used for both heating and cooking, with wood and coal the main fuels used (Dyer, 2000). The medieval cross-passage was a predominant feature in all late medieval houses with more than one room. The passage ran transversely across the building, providing access to the house from both front and rear, dividing the living quarters from the service rooms (Dyer, 2000).

5.5 Late Medieval Trade

As for the previous periods, trade was important and established in coastal and river valleys. London continued to act as one of the most important trade centres in England and from it goods such as fish, spices, wax and jewelry were traded (Dyer, 2000). As in Roman Britain, many medieval markets were controlled by military and administrative factors (Hingley 1989:114 and 115). Many markets developed outside castles and monasteries (Sloane, 1999). The grant of a royal charter to a local lord was a prerequisite for the establishment of a market in the medieval period, so the existence of a local medieval market would therefore have been at the will of the local lord, rather than according to purely economic principles. However, as the population rose, the necessity to establish new markets and trade also increased. Vegetables and livestock were traded in these markets and from the 13th century dried fruits (dates, raisins and prunes) and rice were imported from the continent (Moore and Corbett, 1973). Many ports were established by the sea and rivers which facilitated communication, travel and trade (Dryer, 2000). Cities and towns like London and Thetford became very important centres for trade, and many products and people arrived and departed England to and from the continent (Keene, 1989; Dallas, 1993; Sloane, 1999). By the end of the 15th century, and throughout the 16th century, trade increased enormously and the discovery and conquest of new lands expanded trade, improving the commercial and economic sectors.

5.6 Diet and Economy

Diet during this period was varied and it reflected climatic changes, the effects of population expansion, the work people did and what could be grown. Moore and Corbett (1973: 141) describe the diet during this period in relation to social structure existing at the time. "The diet of the poorer country people probably consisted of coarse black bread, milk, cheese, eggs and occasionally bacon and fowl. Manor servants and farmers ate more meat and their bread was made from less coarsely ground flour. Townspeople also ate more fresh meat and fish and obtained bread of varying quality from the bakers and markets. The rich consumed a great variety of meat, game and fish and their bread was made from fine wheat flour. Vegetables, fruits and imported dried and preserved fruits were available as sweetmeat…" The poor also consumed oatmeal pottage, porridge, eggs, barley bread, ale and vegetable stew. During this period, there was a shift in diet from cereal based foods (bread, oatmeal pottage and ale), towards meat, fish and dairy produce (Hammond, 1993; Dryer, 2000).

The land belonged to the king and peasants and farmers paid their landlords and the church rents with some of the products farmed. As the population increased the work of the land was greater than before, more food was produced, and traded in towns (Hammond, 1993). The rich could afford more food than the poor, greater variety of local and imported vegetables, meats, fowl and fish were also consumed.

(i) Meat

Meats consumed during the Late Medieval period include: cattle, fish, lamb and mutton, goats, horses, fowl, pork and a variety of wild animals and birds (e.g. rabbits, swans and pheasants) (Hammond, 1993; Jones, 1993; Müldner and Richards, 2005). In the later part of the Late Medieval period, the number of young cattle bones found in Britain increased as there was a necessity to supply towns with more meat (Grant, 1989). During the 12th and 13th centuries, meat was plentiful during the warmer months but became scarce in wintertime due to the severe climate change which affected the animals (Lamb, 1995). Within urban centres mature cattle and young sheep bones were predominant, while mature sheep were common at rural settlements (Grant, 1989; Jones, 1993). Pork provided a much larger proportion of the diet of those of high status. With sufficient resources to feed pigs, meat production could be increased without such harmful effects on the environment (Grant, 1989: 142). Animals were not only used for their meat but also for the materials that they provided such as hides, milk (buttermilk, cheese and butter), bone, feathers, eggs and wool (Dyer, 2000).

Based on the large number of remains of salt cod, oysters, mussels, haddock and herring, it appears that during the early part of the 15th century, fish and crustacean consumption increased, possibly supporting the impact of religious dietary rules on the population who prohibited the consumption of meat during fasting (Ayers, 2000; Müldner and Richards, 2005). Evidence of consumption of freshwater fish (pike, pickerel, bream, tench, perch, chubb, dace, trout and eel) is given by the number of ponds constructed around England. Most ponds were built near or in castles, monasteries and important centres. It appears that not everybody had access to the fish; the rich for example, had the right to use the ponds as did those who constructed them (Dyer, 2000). Importantly, the fish were caught in rivers and then transported to the ponds. During the later years of the Late Medieval period, peasants and townsmen held and managed ponds, fish were sold at these ponds, but fish was also consumed locally (Dyer, 2000).

(ii) Cereal, Vegetables and Fruits

As in previous periods farming was a very important activity and cereals were the main products with peas and beans also grown in fields (Hammond, 1993). It is important to note that oats were also grown at higher altitudes (Dyer, 2000). Vegetables such as onions, leeks, spinach, cabbage, celery, coriander, lettuce, carrots, pulses (lentils, beans, peas, etc) and also herbs were also produced in vegetable gardens (Moore and Corbett, 1973:141). The use of gardens increased in the late Medieval period as gardens did not require much investment and administration. Therefore, in both rural and urban settings, gardens of various sizes were developed and expanded (Taylor, 1988; Dyer, 2000).

Many other vegetables and fruits were cultivated during this period (Hammond, 1993; Brothwell and Brothwell, 1998). Apples, strawberries and pears were also produced. As the population increased and farming and pasture areas expanded to woodlands and hills, poor and infertile soils were exploited. This affected peasants as they had to work harder to obtain any returns (Hammond, 1993; Rackham, 1993; Dyer, 2000). Collecting wild produce such as blackberries, blueberries, strawberries along with a variety of seeds and nuts was also performed (Hammond, 1993).

(iii) Salt, Herbs and Spices

At this time, herbs were grown in gardens along with vegetables. Fennel, for example, was cultivated for its seeds and leaves which, if ground, could be used as a spice for seasoning. Many spices were brought from the continent (Hammond, 1993) and salt was used for the preservation of meat, fish and cheese.

(iv) Honey and Sugar

During this period cultivated, wild and dry fruits were consumed which provided some of the sugar in the diet. Honey, milk, cereals and vegetables also supplied some of the sugars needed in the diet. By the 12th century cane sugar and sugar beet was first imported in small amount and only consumed occasionally by the wealthy. By the early 16th century cane sugar was widely consumed by the rich and poor. Sugar was added to desserts, puddings and meals (Hammond, 1993; Hagen, 1995; Brothwell and Brothwell, 1998).

(v) Drinks

The main drinks consumed were beer, milk, buttermilk, cider and water. Beer made from barley became the main drink of the time (Hammond, 1993; Williams, 1994b:10). The brewing of beer with hops became a common activity as a result of the desire to add herbs to preserve it or the desire to change its flavour (Brothwell and Brothwell, 1998:167). During this period, more specifically just after the Norman Conquest, wine production in Britain increased when compared to the Romano-British and Early Medieval periods but, again, only the wealthy could afford wine. With the introduction of wine from other areas of Europe, and the climate and soil conditions in Britain not ideal for vine growing, wine production in England declined again giving strength to the ale and beer production (Brothwell and Brothwell, 1998).

5.7 Occupations and Social Status

As in the Early Medieval period, exploitation of natural resources occurred. However, the feudal system imposed by the Normans gave the king ownership of all lands. Barons, lords and the church kept land for the king, knights protected the land, supervisors and administrators helped in the management of the land and pastures and peasants, farmers, tenants and slaves formed the farming labour force (Williams, 1994; Dyer, 2000). Farming was a common occupation during the late Medieval period, but fishing and use of natural resources such as peat were also common (Dyer, 2000:222). During harvest times male and female, young and old of the poorer classes left their normal jobs to work the land (Dyer, 2000).

It is possible that in market places and towns contact occurred more often between the higher social classes, as part of their duty was to control and maintain communication of all transactions and dealings with the law. On the other hand, poorer individuals did not have easy access to courts and could not afford some of the goods offered in markets (Macfarlane, 1979; Dyer, 2000). As can be seen, landlords acted as the intermediary between the king, the church and labour force by obtaining rents and services from peasants, therefore, landlords achieved a high status. It also encouraged them to acquire more land; in other words, more land, more money and services from the poor. As previously mentioned, the number of small churches built in the lands of high status individuals increased during this period; this is a sign of high status because members of the community needed to commute to these smaller churches to worship, therefore giving importance to the landowner (Drewett *et al.*, 1988).

Importantly, when needed, landlords provided financial or material support for the repair and construction of farm buildings and tools; this of course was done to encourage peasants to work (Macfarlane, 1979; Dyer, 2000). Members of the community not only included farmers, but also local officials, such as court members, jurors, lawyers, administrators, supervisor and cooks. These different occupations also reflect the expansion and increase in population in both urban and rural centres.

Quarries were exploited to obtain stone for building purposes and also to make quernstones (Drewett *et al.*, 1988). It is important to remember that during this period Roman stones and bricks were also used for building. Silver mines were also exploited and developed at this time (Macfarlane, 1979; Dyer, 2000).

During this period, craft specialisation increased, allowing many people to dedicate their time to making goods (e.g. clothes, furniture, leather, bone and wood carvings, ceramics, bricks, candles, glass, baskets, metallurgy, etc) for themselves but most importantly for trade. The cloth industry also increased in which women mainly worked (Dyer, 2000).

5.8 Access to Health Care

As in the previous period, the belief that imbalance in the four humours (blood, yellow bile, black bile and phlegm) could affect the health of a person continued (Nutton, 2004:292). Additionally, during the early years of this period, the relationship between medicine and religion was very strong; being a sinner meant that people would suffer from many diseases (Sournia, 1992; Rawcliffe, 1997; Nutton, 2004). By the 14^{th} century, astrology and astronomy were also used to explain the constitution of the human body and diseases. By the Late Medieval period, interest in learning and medicine had increased with the church and its hospitals continuing to expand and provide charity to the old, the sick and poor (Sournia, 1992; Rawcliffe, 1997 Nutton, 2004). Medical schools and hospitals were established first by the Church but later rich benefactors financially supported the creation of new hospitals or institutions related to medicine (Sournia, 1992; Rawcliffe, 1997).

The establishment of universities propagated medical knowledge and the wealth of the institution. Sournia (1992:150) indicates that "medical students took regular tests over five or six years of studies...each test obliged the candidates to give gifts (cash, hats, gloves, banquets, candles, and furniture) to the school's personnel, vergers of the church, professors". Doctors mainly practiced in towns where they could attract hundreds of patients (Rawcliffe, 1997). Some of the "surgical interventions practiced between the twelfth and fourteenth centuries included: treatment of cranial injury by trepanation, removal of foreign bodies (particularly arrows), ulceration and fistulas. Instruments used included scrapers, chisels, bores, forceps, razors and mallets. Wounds were scraped clean, sutured and then dressed, seared or cauterised. Dislocations and fractures were subject to manipulation" (Roberts and Cox, 2003:251).

In monasteries, monks grew medicinal plants in their gardens (poppy, mandrake, nettle, etc), with honey, salt, vinegar and sugar also being used as medicines (Brothwell and Brothwell, 1998). Some of the treatment for disease included: taking exercise, blood letting, eating certain foods, vomiting, cauterisation and taking baths (Rhodes, 1985; Sournia, 1992; Rawcliffe, 1997). Some Roman baths were "reactivated" during this time and both men and women used them (Sournia 1992). Other remedies included: powder of precious stones, plant bulbs, animal testicles, bile, furs, and red stones to stop the loss of blood and restore pallor, yellow flowers to treat jaundice (Sournia, 1992; Rawcliffe, 1997; Nutton, 2004). Importantly, during this time Black Death victims sought help in monasteries and churches (Gottfried, 1985). The leprous also found support in these religious institutions but also in leprosy hospitals and houses. At the time the leprous were a secluded community and were categorised as sinners (Roberts and Cox, 2003).

During the end of this period new ideas and discoveries in medicine occurred. Dissection of the human body started to take place, as doctors' and surgeons' curiosity prompted them to dissect bodies of criminals and corpses taken from cemeteries. Many people were attracted to the dissections, more for interest, but also to learn about the human body. Amputations also became more common during this time (Sournia 1992, Roberts and Cox, 2003).

5.9 Religion and Burial Practices

Williams (1994b:5) suggests that during this period "the church, through its monasteries, was the centre of learning, art and scholarship." The Christian church was also the centre of power and it influenced the development of towns, the Pope in Rome also had power and influence over English kings. Great numbers of large churches and monasteries were constructed. Many of the castles built also had their own church or chapel (Drewett *et al.*, 1988). Furthermore, the number of small churches built by landowners on their land increased during this period. By the 12th century AD monasteries copied manuscripts and illuminations to promote Christianity and its power. Many scholarly texts (for example, in medicine) were also reproduced (Sournia, 1992). Devotion to religious objects became predominant during this time as Christians found comfort praying to crosses, saint's clothes, bones and tombs.

In the 13th century the church used churchwardens to take care of cemeteries, the church and its possessions (Dyer, 2000). Monks maintained control over their lands and the goods that came from it. During the harvest season, some monasteries employed workers to collect their produce and these workers included members of the community and laymen (Dyer, 2000).

As Christianity was the main religion practiced during this period, the majority of burials were in cemeteries built around churches and monasteries (e.g. Blackfriars Friary, Ipswich, Suffolk and Stratford Langthorne Abbey, Essex) but other locations were also used, for example hospitals (e.g. St. James and St. Mary Magdalene Hospital, Chichester, Sussex and Spitalfields Market, London). High and low status individuals were buried in these hospital cemeteries in an east-west orientation (Lee and Magilton, 1989; Magilton and Lee, 1989). On the other hand, it was very significant to be buried inside, or close to, the church as it was a sacred place, for example those burials from the Royal Mint, St. Mary Graces Priory, London (Waldron, 1993). However, only high status or significant individuals, such as monks and wealthy benefactors, were buried in these locations (Stuart-Macadam, 1985b; Drewett *et al.*, 1988; Stroud, 1993; White, 1999). Based on archaeological evidence (iron nails and wood) some individuals were buried in coffins (Lee and Magilton, 1989; Magilton and Lee, 1989; Mays, 1991), while other individuals were interred in shrouds, or were covered with ash, chalk, Roman tiles and stones (White, 1988; Lee and Magilton, 1989; Magilton and Lee, 1989). Importantly, at the sites of the Royal Mint, London, and Spitalfields Market in London, mass and multiple burials were also found (Waldron, 1993; Conheeney, 1997; Connell, 2002).

As the church was also affected by the Black Death, many English parish churches displayed images of death (Gottfried, 1985; Byrne, 2004). Interestingly, the Christian church started to persecute foreigners, Jews and pilgrims with the excuse that the Black Death had been brought by these individuals' sins (Byrne, 2004). Around England many monasteries, priories and abbeys (for example, Stratford Langthorne Abbey in Essex and Royal Mint, St. Mary Graces Priory in London) were affected by this disease as both clergy and peasants died of this condition (Grainger *et al.*, 1988; Hawkins, 1990; Barber *et al.*, 2004).

During the sixteenth century the political dominance of English Protestantism (the Reformation) could be seen when King Henry VIII, as the leader of the Church of England, stopped relations with the Catholic Church in Rome, between 1529 and 1536, and took power of monasteries and other institutions associated with Rome (Dissolution of monasteries, 1538-1541) (Estep, 1986; Cameron, 1991; Simmons, 2001). Traditional ideas of the Catholic Church were challenged, for example, the importance of the Pope, the beliefs in saints and the Virgin Mary, the idea of purgatory, penances, etc (Estep, 1986; Cameron, 1991). Many protestant groups were created or became established around the 16th century, for example, Reformed Churches (c. AD1500), Lutheranism, Calvinism, Presbyterians, etc. These new religious denominations led to political, social and economic conflicts as time went by (Cameron, 1991).

5.10 The End of the Late Medieval Period

There is not an episode that marks the end of the Late Medieval period but ideas of change brought about by the Renaissance and Reformation during the fifteenth and sixteenth centuries affected every aspect of society, economy and religion (Estep, 1986). From now on the world would be a different one compared to previous periods (Cameron, 1991). Learning and writing reached levels never seen before, science, art, and religion were made available to more people, changing without doubt the history of Britain.

Chapter 6: Material and Methods

6.1 Introduction

This chapter gives a description of the materials and methods used for the project. A description of each archaeological site selected is given including information on the number of individual skeletons excavated, location and history of the site. Figures of Britain are also presented where the sites selected show their geographical position. The methods used to collect the data are explained, as well as the statistical tests performed. Finally, an explanation of the Tables and Figures used is presented.

6.2 Materials: Archaeological sites and skeletal collections selected.

This study was based on published and unpublished data on skeletal health. Skeletal data was not collected by the author, because a large sample for the three periods considered was necessary to make the data more meaningful and to do a comparative analysis to identify if the Early Medieval period health was/was not better than the health from the other periods. The skeletal reports selected needed to satisfy certain criteria which were: the area or region where the archaeological site was located, the number of individuals present, and whether sufficient relevant information was presented on the specific pathological conditions of interest for the research and finally the quality of the data. Sample size for each site selected was 144 + individuals in an effort to have enough individuals by site and facilitate contextual and statistical comparison of data between sites and periods. The high number of individuals was also necessary to compensate for the lack of bones (due to bad preservation, etc) found at any site. It was also important to select a defined geographical region in England, in this case the south and east of Britain, again to make possible and valid comparisons between the sites (it is likely for a defined region to have similar characteristics through time) within periods, and also from the different periods: Romano-British (43 AD to 450 AD), Early Medieval (*c*.450 AD to *c*.1066 AD) and Late Medieval period (*c*.1066 AD to *c*.1600 AD). It is important to note that all the Romano-British sites represent urban living (urban cemeteries). On the other hand, Early Medieval sites represent rural living (agricultural villages, rural cemeteries, hospital, nunnery, church, etc), and the Late Medieval sites present both urban and rural living (Dominican Friary, Cistercian Abbey, churchyard, hospital, priory, etc). The different living environmental contexts (urban and rural) encountered in each site would have affected the levels of stress suffered by individuals in different ways. This provides an important factor to be considered in this research. In addition, it was observed that the Romano-British and Late medieval sites studied in this research span across time within the period, on the other hand, most of the Early Medieval sites fall on the seven century AD. This factor introduces contextual and chronological discrepancies between the sites and periods.

A total of 47 skeletal reports were reviewed to determine which sites would be suitable for this research (for the original list of all the skeletal reports scrutinised, see Appendix A). Following consideration based on the number of individuals studied, the location of the site, presence of pathological conditions and the quality of the data, a total of 21 archaeological/skeletal site reports were chosen (Table 6.1). It is relevant to mention again that as the research intended to study at broad trends (several indicators of stress in the south and east of England from the Romano-British to the Late Medieval period), it involved considering data from more than 21 cemeteries and over 6000 individuals; however financial implications of self-funding limited to study skeletal samples of unpublished data, which explains some of the missing data observed (i.e. juvenile data for Baldock 1, St. Nicholas Shambles, Wicken Bonhunt, Colchester, etc, teeth data for

Great Chesterford, Royal Mint, Baldock, etc and age at death data for several sites). Therefore research concentrated only on secondary published and unpublished material. Importantly, limitations of studying this kind of data were considered.

The skeletal reports selected were also determined by the author having recorded the following stress markers: stature, dental disease (dental caries and enamel hypoplasia), metabolic disease (anaemia (cribra orbitalia), tibial periostitis, age at death). As this was a literature based research, most of the data has been obtained from the skeletal reports themselves, but when access to microfiche and other archived resources were possible, relevant information was taken to complement the data given in the main reports. It was the hope that the analysis of this material would allow comparison between sites and periods and that differences or similarities would be found and be studied.

The skeletal samples selected from each period are described in the following section. (Please note that the reports document contextual data in varying quantities and qualities).

Site Name	Period	Skeletal Sample Size	Skeletal Report by
Baldock 1, Hertfordshire	Romano - British	191	McKinley (1993)
Baldock 3, Hertfordshire	Romano - British	144	Roberts (1984)
Colchester, Butt Road, Essex	Romano - British	575	Pinter-Bellows (1993)
The Eastern Cemetery of Roman London	Romano - British	512	Conheeney (2000a, 2000b)
Winchester, Hampshire	Romano - British	375	Browne, no date
Great Chesterford, Essex	Early Medieval	167	Evison (1994); Waldron (1994b)
Wicken Bonhunt, Essex	Early Medieval	222	Hooper, no date
Nazeingbury, Essex	Early Medieval	154	Puttnam (1978)
Buckland, Dover, Kent	Early Medieval	162	Evison (1987); Powers and Cullen (1987)
Eccles, Kent	Early Medieval	169	Boocock, Manchester and Roberts (1995)
Staunch Meadow, Brandon, Suffolk	Early Medieval	158	Anderson (1990)
Edix Hill, Barrington, Cambrigeshire	Early Medieval	148	Duhig (1998)
North Elmham Park, Norfolk	Early Medieval	206	Wells and Cayton (1980)
Burgh Castle, Norfolk	Early Medieval	197	Anderson & Birkett (1991, 1993)
Blackfriars Friary, Ipswich, Suffolk	Late Medieval	250	Mays (1991)
St James and St Mary Magdalene Hospital, Chichester, Sussex	Late Medieval	384	Magilton & Lee (1989), Lee & Magilton (1989)
Royal Mint, St Mary Graces Priory, London	Late Medieval	934	Waldron (1993)
St. Nicholas Shambles, London	Late Medieval	234	White (1988)
Spitalfields Market, London	Late Medieval	200	Connell (2002); Conheeney (1997)
Thetford, Norfolk	Late Medieval	149	Stroud (1993)
Stratford Langthorne Abbey, Essex	Late Medieval	647	Stuart-Macadam (1985b, 1986) White (1999)

Table 6.1 List of sites studied

6.2.1 Romano-British period (5 sites, Figure 6.1):

(i) Baldock I, Hertfordshire:

Baldock is a town located in the south-east region of England, in north-eastern Hertfordshire (OS: Ordnance Survey grid reference number TL247337). It is thirty seven miles from London (Westell and Applebaum, 1933) and was a Belgic settlement before the Romano-British period. The cemetery site of Baldock I was studied during 1925, 1926, 1932 and late 1980's and was dated to the Flavian dynasty (69 AD to 96AD). Roman vessels and pottery, coins and burials were found, along with bronze (pins, bangles, bracelets) and iron (keys, horse-spur, razor, needles, etc) artefacts (Westell, 1931). The site consists of 191 individuals (74 males, 50 females, 5 adults of undetermined sex and 62 juveniles) who were excavated from three areas of the site: Area 12 had six individuals; Area 15 had 184 individuals and Area 31 only one individual. The preservation of the skeletal material was good, with signs of some root and rodent activity, between 75% and 90 % of the skeleton was preserved (McKinley, 1993). During the Romano-British period, there was an extensive community at Baldock (Westell, 1931:255) which relied intensely on agriculture, including wheat-growing and sheep-rearing. However, evidence for the consumption of oysters, beef and wild-boar was found (Westell, 1931). The geographical position of Baldock permitted it to be a centre of importance because it was the meeting place of several Roman roads (Icknield Way and Stane Street to London, Braughing, Sandy, Welwyn, Dunstable, the Cambridge area and the north). This location allowed for both local and regional trade (Burleigh, 1982). Elaborate mosaic pavements in houses and pottery in burials are evidence of prosperity during the 2nd century AD at Baldock and markets flourished where agriculture products were traded. However, by the 3rd century, economic changes occurred introducing insecurity and poverty to the area, and by the 4th century some people moved to the country or to fortified towns, reducing the population. In 367 AD armies were routed to different areas of the province leaving the countryside overrun and plundered by numerous invaders (Applebaum, 1958). By the 5th century the Roman settlement was deserted until the 12th century when the Knights Templar established Baldock as a market town which was served by the roads originally used by the Romans (Westell, 1931; Westell and Applebaum, 1933; Burleigh, 1982).

(ii) Baldock 3, Hertfordshire:

For general information about the area see Baldock I summary (above). The site of Baldock 3 was excavated between 1980 and 1985. Burials and artefacts found have been dated to the second half of the 4th century AD and early 5th century AD and are associated with a site located at a Roman crossroads (Roberts, 1984). A total of 144 individuals were studied (45 males, 63 females, 21 adults of undetermined sex and 15 juveniles) and the majority of the burials were found in a ditched enclosure (Roberts, 1984:1). A great proportion of the skeletal material was affected by erosion and some bones were badly fragmented post mortem, especially the skull and pelvis, consequently affecting the information that could be obtained (Roberts, 1984). The OS grid reference for Baldock 3 is TL 250341.

(iii) Colchester, Butt Road, Essex:

Colchester (Camulodunum) was one of the earliest centres of Romanisation in Britain and by the late Roman period is was an established Roman town (Crummy et al., 1993; Watts, 1993). The Roman occupation of the area extended from the first century AD to the fifth century AD (Crummy, 1993). During the Saxon raids, rural areas around Colchester were abandoned in favour of the security offered within the town walls (Crummy *et al.*, 1993: 263). Around 60 AD Colchester was destroyed during the Boudiccan revolt. The urban cemetery at Butt Road, Colchester was excavated during

1976 to 1979, then again in 1986 and in 1988. The OS grid reference for the site is TL995255, and it is located by the river Colne in an area of low annual rainfall (Dobney et al., 1997). The site is "opposite the south-west corner of the walled area of the Roman town, some 250 metres from the main south-west gate" (Crummy *et al.*, 1993:5). Several pottery vessels from different areas of Britain have been found at the site, supporting the importance of trade in Colchester (Going, 1993).

In total 575 individuals (170 males, 140 females, 157 adults of undetermined sex and 108 juveniles) dated from around 320 AD to 400 AD were studied (Pinter-Bellows, 1993). The preservation of the skeletal material ranged from good to very poor as some remains were affected by roots of trees and other vegetation and others by construction during the 19th century (Pinter-Bellows, 1993). The estimated cemetery population was between 1300 and 1400 individuals (Crummy *et al.*, 1993:7). Colchester had a church and a cemetery where most burials had an orientation west-east, and a supine and extended position. This supports the idea of a large Christian community living in the area during the late Roman period which later spread to rural areas (Watts, 1993). Most of the burials were buried in timber coffins, but there were some interred in hollowed tree trunks, and tiles or un-coffin graves or directly into the ground with few artefacts or nothing at all (Crummy *et al.*, 1993). Some individuals were buried in areas other than cemeteries such as areas used for agriculture and building construction (Crummy, 1993).

(iv) The Eastern Cemetery of Roman London:

This Roman civic cemetery dates back to the first to the fifth century AD (mainly second to fifth century AD) and it was excavated between 1983 and 1990 (Barber and Bowsher, 2000; Conheeney, 2000a; McKinley, 2000). The OS grid reference for this site is TL 336 814. The site consists of 512 individuals (186 males, 109 females, 88 adults of undetermined sex and 129 juveniles) which represent a normal urban population that were born and buried locally in London (Londinium) (Conheeney, 2000a, 2000b). According to Conheeney (2000a:280) "individuals were strikingly uniform in their skull shape (mesocranial) and type, being robust, with even many of the females having characteristics generally accepted as male around the jaw line". However, it is important to remember that it is likely that many individuals were immigrants from other areas of the Roman Empire. Preservation of the skeletal material was very variable, even within a single skeleton. In general, skeletal remains were fragmented as graves had been disturbed by later burials and building development (Conheeney, 2000b). It is also important to note that 92 individuals were cremated burials (McKinley, 2000). However, the data from these cremated individuals were not included in this research, as much of the information needed was unavailable. The minimum estimate for the cemetery population ranges from between 13,536 and 180,480 individuals (calculated from the smallest possible cemetery area and the full range of burials density on the excavated site) (Barber and Bowsher, 2000). However, between 500,000 and 1,000,000 may have been buried at this cemetery during the Romano-British period (Barber and Bowsher, 2000; Conheeney, 2000a, 2000b). Different burial practices were encountered: prone burials, displaced skulls, grave goods (pipe clay figurines, coins, tools, clothing pins, ceramic, glass and some animal bones), and chalk and container type burials. Some areas of the cemetery were assigned only for males or females, young or old, perhaps reflecting status (Conheeney, 2000a), but tombstones were not common in the cemetery. Importantly, Londinium was a highly urbanised and administrative centre which attracted people from other settlements to work and trade (Barber and Bowsher, 2000; Conheeney, 2000a, 2000b).

(v) Winchester, Hampshire:

The Roman town of Winchester (Venta Belgarum or Market of the Belgae) was founded around 70 AD as an administrative division (civitas) of the Roman Empire. A stone wall surrounded the important buildings of the town and several cemeteries were used. Both salvage and controlled excavations were performed. The OS grid reference number is SU 485 295. This archaeological site dates to the third to the fourth century AD. The site consists of 375 individuals: 103 males, 76 females, 42 adults of undetermined sex, 10 adults of undetermined age and 144 juveniles, which were excavated from three Roman cemeteries. The Northern Cemetery included excavation at Victoria Road, Victoria Road North, Hyde Street, Cattle Market Car Park, Saxon Road and 16 Hyde Close; the Western Cemetery had excavations at New Road, Clifton Road, 22-34 Romsey Road, 45 Romsey Road and Carfax and the Eastern Cemetery included excavations at Chester Road, St. John Street and St. Martin's Close) (Browne, no date: 9). According to Browne (no date:1) much of the disarticulated bone was not included in the report, over a third of the burials were well preserved, and the eastern cemetery had the highest proportion of poorly preserved burials. Interestingly, trauma was the most frequent pathological condition recorded and it seems that an area of the cemetery was dedicated to the burial of children (Browne, no date: 4 and 6).

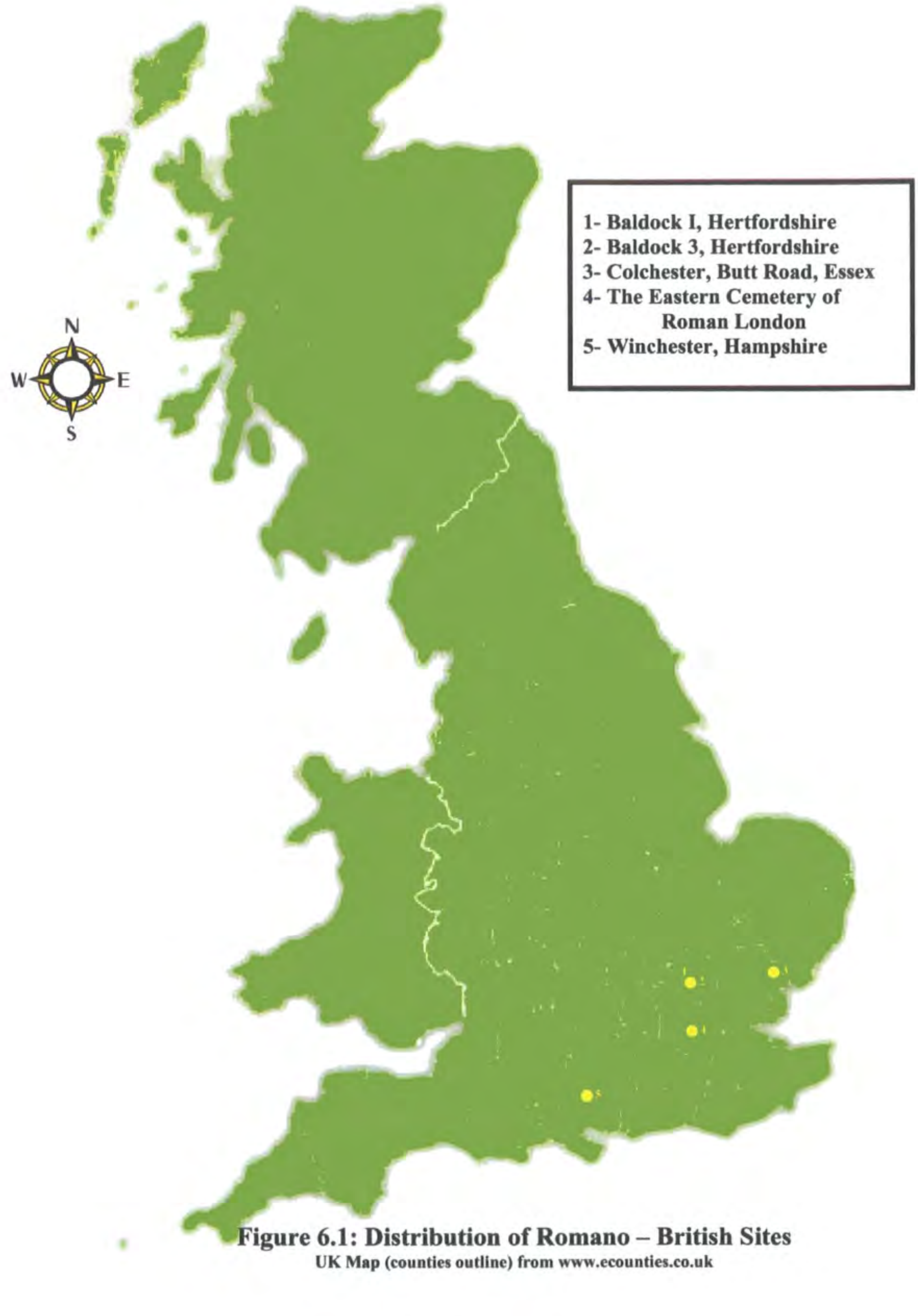


Figure 6.1: Distribution of Romano – British Sites

UK Map (counties outline) from www.ecounties.co.uk

6.2.2 Early Medieval period (9 sites, Figure 6.2):

(i) Great Chesterford, Essex:

This Early Medieval site is located on the east bank of the River Cam, south of Cambridge (north-west of the Roman town of Great Chesterford) (Evison, 1994); its OS grid reference is TL 501435. This pagan Saxon cemetery dates back to *c*.450 AD- *c*.650 AD, but, most of the burials are from the 6th century AD (Evison, 1994). It was excavated between 1953 and 1955 by the Inspectorate of Ancient Monuments as a salvage excavation due to industrial gravel digging (Draper, 1986; Evison, 1994). The site consists of 167 individuals: 35 males, 43 females, 83 juveniles and 6 adults of undetermined sex, which displayed many pathological changes. Some of the skeletal remains were either too damaged or incomplete to study (Waldron, 1994b). According to Evison (1994: xi) "There was an unusually large percentages of children's graves, probably reflecting a more accurate picture than usual of the normal mortality rate in Anglo-Saxon times". Interestingly, two females had foetal skulls in their pelvic areas on excavation (Waldron, 1994b). Burials had an orientation of S-N (head to the south) and W-E (head to the west) (Evison, 1994:36). There were also 31 cremations found, but these were not included, for reasons discussed above.

Several artefacts were found at the site mostly in female graves; these included: wrist clasps, cone beakers (glass), bronze bowls, combs, beads, pendants, bracelets, pins, pottery, knives, ivory rings and brooches, many of which were brought from the continent (northern France and Germany) and obviously traded in Britain (Draper, 1986; Evison, 1994; Heyworth, 1994). Communication and trade was facilitated by the River Cam and by Roman roads from London, Colchester and Cambridge (Evison, 1994:49). Interestingly two male graves contained horse remains, swords, spears and a shield boss: perhaps they belonged to important individuals. Perforated coins were also found on necklaces of some juvenile burials (Evison, 1994). It is relevant to note that not all the burials had artefacts. A number of animal bones were also excavated from the site (sheep, ox, boar, goose, roe deer, goat, dog, domestic fowl and cattle) and few duck eggs (Serjeantson, 1994).

(ii) Wicken Bonhunt, Essex:

This Early Medieval site was excavated in 1968-9 by Bari Hooper and in 1970-4 by Keith Wade. The unpublished report by Hooper includes information on both excavations. A total of 222 individuals: 94 males, 59 females, 13 adults of undetermined sex and 56 juveniles were studied. It seems that occupation of the site stopped at the end of the Middle Saxon period (*c*.650 AD – *c*.800 AD) (Hooper, no date). Due to the low acidity of the clay matrix, the skeletal material was in a reasonably good state of preservation, but, some farming from the medieval and modern times (including building of stables, byres and styes) and later burial activity contributed to the damage found (Hooper, no date: 1). Interestingly, several male individuals (approximately 19 adults) display weapon wounds on the skull, mandible, scapula, humerus, ribs, and vertebrae (perhaps from arrows, knives, axes and swords) (Hooper, no date: 26). Today the skeletal material is curated at the Saffron Walden Museum in Essex.

(iii) Nazeingbury, Essex:

This Early Medieval site dates back to the 7^{th} to the 9^{th} century AD (*c*.650 AD-*c*.870 AD) and was discovered in 1934 during construction work (Huggins, 1978:31). Interestingly, a Romano-British site was also found in the same area. The geographical position of the Early Medieval site is: OS grid reference TL386 066 (Easting 538600 and Northing 206600). The site was excavated because of rescue work between 1975 and 1976 by the Waltham Abbey Historical Society and the skeletal material is curated in Duckworth Laboratory, University of Cambridge (Huggins, 1978). It is believed that the site was possible a hospital associated with a nunnery between 660 AD and 870 AD; this is based on the large number of females recovered (Huggins, 1978; Putnam, 1978). The site consists of 154 individuals (34 males, 88 females, 15 adults of undetermined sex and 17 juveniles), some of which were in poor condition. For example, most skulls were broken post-mortem (Putnam, 1978:54) due to gravel digging, construction of nursery latrines and concrete roads (Huggins, 1978; Putnam, 1978). Most of the skeletal remains were "extended on the back, with head to the west in Christian fashion" (Huggins, 1978:49).

The community was a religious one which took care of the sick (Putnam, 1978:56). A list of the food (based on a diet described for the canons) that was available for the community included: bread, various meats, ale, blackbirds, magpies, pheasant, geese, chickens, and wine. Pottery (Saxon, Belgic and Romano-British shreds), loom-weights, iron objects (key, hooks, spike, nails, etc), coins, clay objects, bronze objects (pins, tweezers, brooch, etc), bone pins, animal bones (goat, sheep, pig, deer, ox, chicken, goose, etc) and postholes were also excavated (Huggins, 1978). Huggins (1978:76) explains "that the area had been used for cultivation and meadowland from at least the eleventh century until the nursery development of the twenty century".

(iv) Buckland, Dover, Kent:

This early Anglo-Saxon cemetery dates back to the 5th to the 7th century AD (*c*.450AD - *c*.650 AD), but there is evidence that the site may have been used in different periods as there is a prehistoric barrow ditch, Romano-British pit and Early and Late Medieval burials (Evison, 1987:15). The site OS grid reference is TR 310430.

The site was excavated between 1951 and 1953 (Evison, 1987). In total 162 individuals (54 males, 66 females and 42 juveniles) were studied (Powers and Cullen, 1987). Post-mortem erosion, animal and modern agricultural disturbance (cultivation, road and railway work) affected preservation of some of the teeth, orbits and skeletal material found which made diagnosis of pathological conditions difficult (Evison, 1987: 16; Powers and Cullen, 1987:197 & 198).

Interestingly, some male and female individuals were buried with a knife, placed by the waist area of the body or inside bags (Evison, 1987:113), and a foetus was buried with one female individual (Evison, 1987). Other grave goods recovered at this site were: weapons (swords, spears, arrows, axes, and shields), jewellery (brooches, pendants, beads, pins, bracelets, rings, etc) and others (combs made of bone, pottery, glass, bronze bowls, keys, coins, etc). Many of these artefacts were brought to England from the continent and Scandinavia (swords, shields, garnet discs brooches, saucer brooch, beads, wheel-thrown pottery, etc) but there were also local artefacts (pottery) (Evison, 1987). Remains of large sunken-floor buildings were found at the site.

It is important to note that Kent was the entry and exit point of many products from the continent and it was also a manufacturing centre with a mint. At Kent, gold and precious stones brought from the Continent were transformed into jewellery (i.e. disc brooches, rings, bracelets, etc) which in time were traded locally and abroad (Drewett *et al.*, 1988).

(v) Eccles, Kent:

This Early Medieval site was excavated between 1970 and 1976, but most of the skeletal remains were excavated between 1970 and 1974 (Shaw, 1994; Boocock *et al.*, 1995). The OS grid reference of the site is: TQ 722605, located at Rowe Place Farm, Eccles. The cemetery was found in the south east wing of a Romano-British villa (Shaw, 1994). The site dates back to the mid-seventh century AD and consists of 169 individuals (72 males, 61 females and 36 juveniles) which are curated at Bradford University (Department of Archaeological Sciences) (Boocock *et al.*, 1995). Most of the burials had an east-west orientation (Shaw, 1994:165). As an agricultural community, the site had been affected by ploughing and several skeletal remains were disarticulated, incomplete and fragmented (Shaw, 1994; Boocock *et al.*, 1995). Importantly some of the burials had grave goods (coins, flint blade, iron knife, spearhead, copper ring, spindle whorl, copper buckle, pins, pottery, comb and needle) but not all, one individual suffered from leprosy and some had injuries produced possibly by a sharp weapon (Hawkes, 1973; Shaw, 1994; Boocock *et al.*, 1995).

(vi) Staunch Meadow, Brandon, Suffolk:

At Staunch Meadow two cemeteries were excavated, but, all the skeletal analysis done was based on one cemetery (cemetery 1) as the second cemetery was not fully excavated. Cemetery One dates back to around 650 AD to 800AD and was located south of the Middle Saxon church and settlement by the south bank of the River Little Ouse. The cemetery OS grid reference is TL 7790 8656 (Carr *et al.*, 1988; Anderson, 1990). The site consists of 158 individuals (57 males, 41 females, 25 adults of undetermined sex and 35 juveniles) with the skeletal material in poor or fair condition, due to the acidic nature of the soil. However, modern grave digging activity also affected the preservation of the material (Anderson, 1990:3).

Several artefacts and features associated with the settlement were found: rectangular buildings, pits, ditches, hearths, postholes, glass, pottery, coins, iron, copper objects and bone objects, animal bones, etc. Remains of an Iron Age settlement has also been found in this area (Carr *et al.*, 1988).

(vii) Edix Hill, Barrington, Cambridgeshire:

The site of Edix Hill (also known as Edricks Hill and Edics Hill Hole) is located on the western edge of Barrington Parish (close to Orwell). Its OS grid reference is TL 395495. The area has a history of Iron Age, Romano-British and Early Medieval settlements (Malim and Hines, 1998). This pagan Anglo-Saxon cemetery dates back from around 500 AD to the early 7^{th} century AD and was excavated between 1987 and 1991 (Malim and Hines, 1998). The site consists of 148 individuals (48 males, 40 females, 14 adults of undetermined sex and 46 juveniles) whose bone size and muscular marking were robust (Duhig, 1998).

More than half of the males were buried with a weapon in their graves. Several of the artefacts buried with the dead were glass amber beads, annular brooches, spear heads, shields, buckles, knifes, iron pins, etc, and some juveniles and a leprous individual also had grave goods (Malim and Hines, 1998: 294). Some graves had multiple burials (two or more bodies in a single grave) (Duhig, 1998) and, importantly, a number of individuals (males) had healed injuries (Duhig, 1998:294). Several burials were affected (breakage of post-cranial bones and skulls) by ploughing and drainage works (Duhig, 1998; Malim and Hines, 1998).

(viii) North Elmham Park, Norwich, Norfolk:

This early Christian site (cathedral cemetery) dates back to the 10^{th} to the 11^{th} centuries AD (*c.*950 – *c.* 1066 AD) and was excavated between 1967 and 1972 (Wade-Martins, 1980). The OS grid reference for the site is TF987215. The site consist of 206 individuals (82 males, 76 females, 9 adults of undetermined sex and 39 juveniles), some of which were in a poor condition due to post-mortem soil erosion leading to burials where the skeletal remains were complete (Wells and Cayton, 1980). There is evidence (animal and plant remains) that at this site meat and cereal grain (bread) were consumed. According to Wells and Cayton (1980:281) this population was "relatively healthy"...with evidence of several diseases absent: "leprosy, tuberculosis, syphilis, rickets, scurvy, congenital dislocation and cleft palate". Several buildings, ditches and wells were also found (Wade-Martins, 1980). Systematic planning seems to have taken placed in the organization of this town as this is observed in the street system planned (Wilson, 1972).

(ix) Burgh Castle, Norfolk:

This Middle Saxon (*c.* 650AD – *c.* 950 AD) Christian cemetery was excavated between 1958 and 1961; its OS grid reference is TG 474 045 (Anderson and Birkett, 1991, 1993). In total, 197 individuals were studied at this secular site (79 males, 64 females, 24 adults of undetermined sex and 30 juveniles) and most of them were in a fair condition (Anderson and Birkett, 1991, 1993), while some remains were in a good or poor condition (Anderson and Birkett, 1991:2).

Figure 6.2: Distribution of Early Medieval Sites
UK Map (counties outline) from www.ecounties.co.uk

6.2.3 Late Medieval period (7 sites, Figure 6.3):

(i) Blackfriars Friary, School Street, Ipswich, Suffolk:

The skeletal remains studied at this Dominican Friary were buried between 1263 AD and 1538 AD; its OS grid reference is TM165445 (Mays, 1991). The site was excavated between 1983 and 1985 and it consists of 250 individuals (148 males, 64 females, 14 adults of undetermined sex and 24 juveniles) whose preservation varied from good to poor (Mays, 1991:3). It is believed that the male population represents a combination of friars and lay-folk as females could not be friars (Mays, 1991:16). Interestingly, there is evidence (iron nails, soil stain and wood) that coffins were used for a number of burials (Mays, 1991).

(ii) St. James and St. Mary Magdalene Hospital, Chichester, Sussex:

This Late Medieval leprous hospital cemetery dates between the 12th to the 17th centuries AD. It was founded around 1118 AD as a leprosy hospital but later (1535-40 AD) on it became an almshouse (charitable house or residence). Around 1540 AD sisters and children were admitted to the hospital as before this time only important male individuals and benefactors were patients (Lee and Magilton, 1989; Magilton and Lee, 1989). The hospital was run by a chaplain or master, assisted by a prior, and the chaplain gave consent to admit patients (Lee and Magilton, 1989: 274). Its OS grid reference is SU 873055. The site was excavated between 1986 and 1987 by Chichester District Archaeological Unit and it consists of 384 individuals (191 males, 75 females, 18 adults of undetermined sex and 100 juveniles) some of which were buried in coffins (nails) in an east-west position (Lee and Magilton, 1989; Magilton and Lee, 1989). A number of graves had (pillows) stones on both sides of the skull, perhaps to keep the head in position (Magilton and Lee, 1989:256).

During the Roman and Late Medieval periods, Chichester was an important market centre and port with a harbour at Dell Quay two miles south-west of the city (Magilton and Lee, 1989: 248). Trade between Chichester and the continent and London were evident (Magilton and Lee, 1989). Around 1947 construction of new houses revealed the cemetery and some of this construction work affected the preservation of the skeletal material.

(iii) Royal Mint, St. Mary Graces Priory, London:

This Late Medieval cemetery dates to the 14^{th} to the 16^{th} centuries AD. It is a pre-reformation Christian Black Death cemetery associated with a Cistercian Abbey (Grainger *et al.*, 1988; Hawkins, 1990). The cemetery includes church tombs from the abbey's choir and presbytery area and Black Death burials from three mass graves. The OS grid reference for this site is TQ 339807, and it is located in the north-east of the Tower of London. The site was excavated between 1986 and 1988. The site consists of 934 individuals (376 males, 249 females, 65 adults of undetermined sex and 244 juveniles) which were found evenly distributed around the cemetery (Hawkins, 1990; Waldron, 1993). There is evidence that late burials cut into earlier graves and a great amount of redeposit bone was excavated (Grainger *et al.*, 1988; Waldron, 1993). Several individuals were buried in coffins and shrouds, or had ash or charcoal placed over them (Hawkins, 1990:640). Both males and females were interred in trenches and graves, and a few graves contained multiple burials (adults and infants). Some artefacts recovered at this site included: belt buckles, coins hoards and nails (Grainger *et al.*, 1988).

(iv) St. Nicholas Shambles, London:

This pre-Reformation Christian cemetery dates to the 11th to the 12th centuries AD. Its OS grid reference is TQ 3205081350, and it is located in Newgate Street (White, 1988). The church cemetery was excavated between 1975 and 1977 by the Museum of London and it consisted of 234 individuals (90 males, 77 females, 21 adults of undetermined sex and 46 juveniles), some of which were buried with loose stones, Roman tiles, and chalk, and some had pebbles placed in the mouth. Most individuals were "fairly intact", however, a number of skulls were damaged possible by later burials, the fragmentary nature of the soil deposits and erosion (White, 1988: 18). White (1988:48) describes the population as "homogeneous with little exogamy and outward movements". This conclusion was based on anthropometry and the evidence that juveniles were buried in the same area as the adults. Some wood, pottery and ceramics were recovered at the site (White, 1988). Interestingly, a female was found with the remains of a full term foetus in her abdomen (Wells, 1988:71).

(v) Spitalfields Market, London:

This Late Medieval hospital and priory (London's largest medieval hospital) was founded in 1197 AD by important merchants and closed during the Dissolution in 1538 AD. The site was excavated between 1998 and 2001 by the Museum of London Archaeological Service (MoLAS) (Thomas *et al.*, 1997; Connell, 2002), but some excavation had occurred at this site since 1982, in 1992 and 1997 (Conheeney, 1997; Thomas *et al.*, 1997). Interestingly, around 10,534 individuals (including Romano-British, Medieval and Post Medieval) have been excavated at this cemetery, making it the largest cemetery excavation performed in England (Connell, 2002:7). The OS grid reference for the site is TQ3345 8195. The Late Medieval sample studied here consists of 200 (out of 10,417) individuals (83 males, 76 females, 9 adults of undetermined sex and 32 juveniles) of which 100 were from a cemetery setting (single inhumations and multiple burials) and 100 were from mass grave pits (Connell, 2002). More than half of the skeletal remains were in a very good condition, but, some were affected by later burials which produced a large amount of disarticulated material, and an extension of the Spitalfields Market in 1926 destroyed some of the graves (Connell, 2002:12, 13, 88). This skeletal collection is curated at the Museum of London (Connell, 2002).

The remains of a stone chapel were also discovered at this site. The important location of London, allowed communication, contact and trade with the continent and other regions outside London (Keene, 1989; Connell, 2002), "the cemetery served the general community, those derived from the infirmary plus high status burials of monks, lay sisters and wealthy benefactors" Connell (2002:80). During the 14th century new drainage systems and latrines were built in the hospital (Thomas *et al.*, 1997).

(vi) Thetford, Norfolk:

This Late Medieval parish church cemetery dates from the 11th century AD to the 12th centuries AD and excavations in this area took place between 1964 and 1970. The church cemetery, however, was excavated between 1969 and 1970 (Dallas, 1993). The OS grid reference for the site is TL8705 8231. The skeletal sample consists (information from microfiche) of 149 individuals (19 males, 21 females, 47 adults of undetermined sex and 62 juveniles) which ranged in their preservation levels (Stroud, 1993). Stroud (1993:168, 175) explains that some teeth were in a poor condition "often specked or covered with a black deposit and sometimes with post-mortem chipping of the enamel" and that some tibiae were in a poor condition. Disturbance of the skeletal remains came from excavation of new graves and digging of a modern sewer drain and the acidity of the soil lead to post-mortem destruction of the skeletons (Dallas, 1993;

Stroud, 1993). Trabecular bone showed more damage than the compact bone (Stroud, 1993).

The important geographical position of Thetford, close to rivers and the coast and on a relevant north-south and east-west trade and communication route, allowed it to develop as an important trade centre during the Early Medieval period and expand in the Late Medieval period (Dallas, 1993; Stroud, 1993). Based on the numbers of kilns found around Thetford, it can be assumed that Thetford pottery (hard grey wheel-turned) was traded at this site. Stroud (1993:175) mentions that "the presence of almost the same amount of males and females and the increased number of children shows a normal community". A number of animal bones were also recovered at this site, i.e. sheep, cattle, and pig, some of which had evidence of being slaughtered (Jones, 1993).

(vii) Stratford Langthorne Abbey (St. Mary), Essex:

This Cistercian monastery was founded by William de Montfichet in 1135 AD and abandoned in 1538 AD due to the Dissolution. Its OS grid reference is TQ3902 8340 (Stuart-Macadam, 1986; White, 1999; Barber *et al.*, 2004). The site was discovered during railway work and excavated in 1983 by the Oxford Archaeology Unit and in 1994 by the Passmore Edwards Museum Archaeological services (Stuart-Macadam, 1985b; 1986; Barber *et al.*, 2004). The skeletal material consists of 647 individuals (536 males, 28 females, 55 adults of undetermined sex and 28 juveniles) of which preservation varied from good to very good, with only a few skeletons found to be in poor condition (Stuart-Macadam, 1985b; White, 1999:2). White (1999:4, 17) suggests that it appears that no spatial separation or segregation existed in the placement of bodies in the cemetery. Importantly, clergy, younger monks and lay brothers and members of the community were buried in the same area of the cemetery and most importantly, based on the sex- bias, more males than females were found among the burials.

This site represents a medieval monastic establishment. Artefacts found included: a glass goblet, buckles, stirrups, remains of a chapel and infirmary complex. It is possible that some of the artefacts were obtained in London (Stuart-Macadam, 1985b; White, 1999; Barber *et al.*, 2004). Interestingly, during its existence, the Abbey was affected by the Black Death (1349), the Peasants Revolt (1381) and flooding in the 14th century (White, 1999; Barber *et al.*, 2004). Some skeletal remains have recently been reburied at Sutton Coldfield Abbey, Birmingham (Barber *et al.*, 2004).

Figure 6.3: Distribution of Late Medieval Sites

UK Map (counties outline) from www.ecounties.co.uk

6.2.3.1 Summary

Of the 21sites studied, the Romano-British sites had a total of 1797 individuals, the Early Medieval sites had 1583 individuals, and the Late Medieval had 2798 individuals, with data from an overall total of 6178 individuals considered. In Figure 6.4 all the 21 sites are plotted to show the distribution of the sites across the south and east England. As previously mentioned, all the Romano-British sites represent urban living (urban cemeteries). On the other hand, Early Medieval sites represent rural living (agricultural village cemeteries, hospital, nunnery, church, pit, etc), and the Late Medieval sites present both urban and rural living (Dominican Friary, Cistercian Abbey, churchyard, hospital, priory, etc).

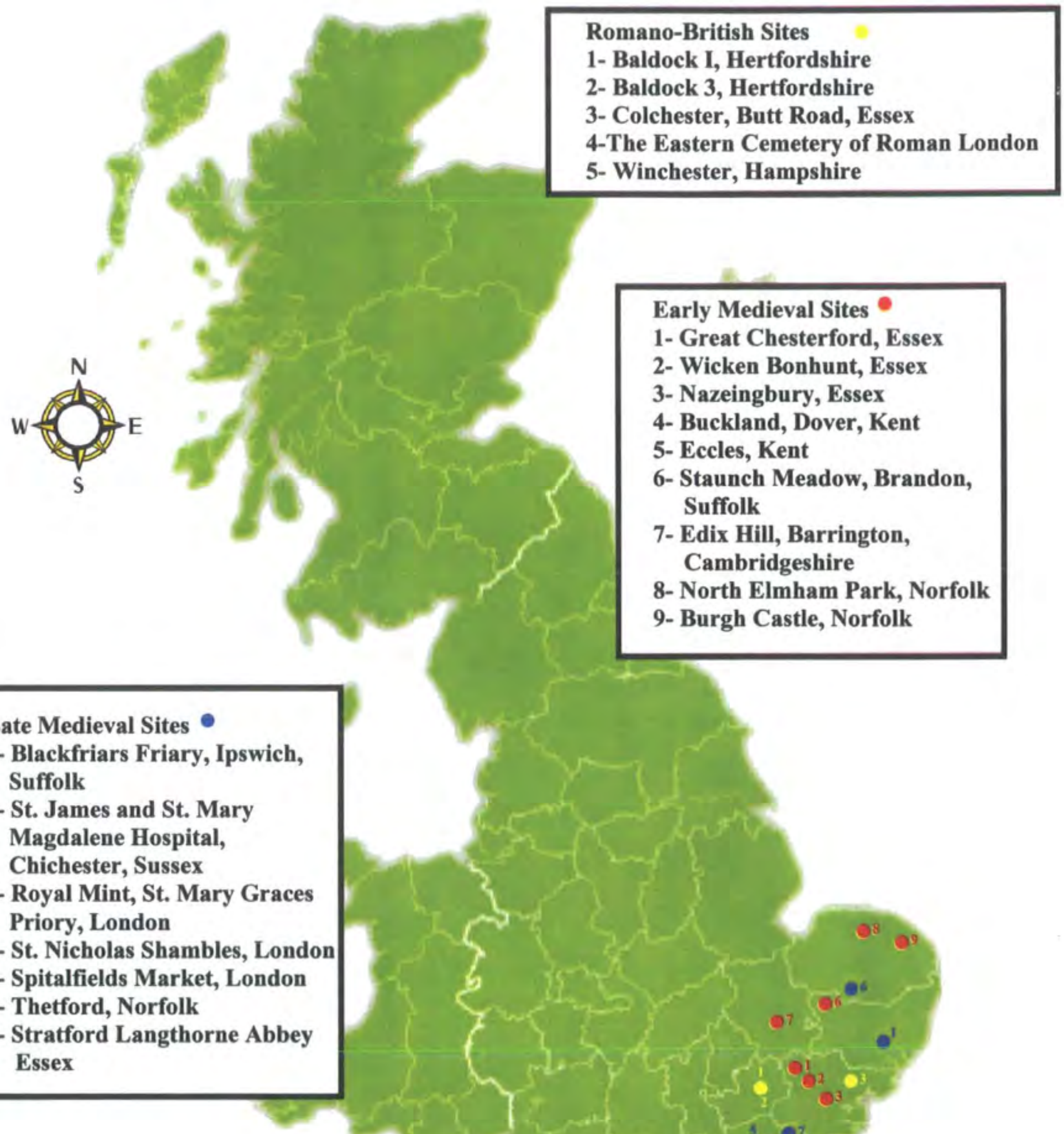


Figure 6.4: Distribution of All Sites

UK Map (counties outline) from www.ecounties.co.uk

6.3 Methods

Each skeletal report was scrutinised throughout using the criteria for selection described above.

6.3.1 Data Collected: Explanation

Data obtained from the skeletal reports were recorded on printed record forms (for an example see Appendix B) which were adapted from Caffell (2004). After many changes made in the recording form and before using the final recording design, the forms were assessed for use by recording several skeletal reports selected at random. Repeatability was achieved and the form proved to be acceptable for the information that needed to be collected. Data recorded included: site name, period, location, minimum number of individuals, sex, age at death, stature, dental caries, enamel hypoplasia, tibial periostitis, cribra orbitalia, relevant contextual data in palaeopathology and general notes (for a list of the data collected see Appendix C). Later, all the data collected was transferred to an electronic database using Microsoft Office Excel 2003. A laptop was purchased to facilitate the recording process. The recording was kept simple in order to document the large number of individuals and make the data more representative of the periods studied (See Appendix D (1-10) for the Data in Microsoft Excel sheets).

6.3.2 Sex Determination

The methods for sexing and ageing skeletal remains differed considerably between reports, questioning the final interpretation of the reports. Making comparisons between them was difficult if not impossible at times (for a list of the methods used in each skeletal report, see Appendix E). However, the most commonly used methods for determining the sex of individuals are based on pelvic (sacrum, acetabulum, sciatic notch, subpubic angle, ventral arch, obturator foramen) and skull (mastoid processes, chin, orbital rims, nuchal crest, supraorbital ridges, bossing, forehead, mandibular ramus flexure and zygomatic arch) morphology (Bass, 1987), and long bone dimensions (humerus head diameter, femoral head diameter, femoral bicondylar width, clavicle length, scapula glenoid cavity width and radial head diameter) (Dwight, 1905; Bass, 1987). Sexing adult skeletal remains is facilitated because puberty has taken place, and the changes associated with particular sexes are more evident. On the other hand, sexing juvenile skeletons is impossible to accomplish by focussing on morphological changes due to the fact that secondary sex characteristics do not appear until puberty has set in. The only reliable method to estimate sex of juvenile individuals is through biomolecular work (DNA analysis) (Pääbo, 1985; Hagelberg *et al.*, 1989; Stone *et al.*, 1996). However, this method is expensive for bioarchaeologists, and depends on ancient mitochondrial DNA surviving, and an expert is needed to conduct the analysis.

Before estimation of sex in skeletal remains is done, it is important to keep in mind that some skeletons may display male and female characteristics, and that different population groups may show variation in the expression of sexually dimorphic traits, "activity" and occupations may also contribute to the development of robust skeletons in both male and female individuals (White, 2000). The categories used in this research for sex allocation were the following: male, female, adult of undetermined sex and juvenile. It is relevant to mention that when a skeletal report assigned a label of possible or probable male or female to an individual, this individual was added to the total of males or females respectively. The use of broad categories could help dealing with the problem of inter-observer error. Adults of undetermined sex and juveniles were not of course added to the total of males and females.

6.3.3 Age Determination

For the determination of age of skeletal remains the following methods used in the skeletal reports considered were: epiphyseal fusion (Bass, 1987), dental development (Van Beek, 1983; Bass, 1987; Buikstra and Ubelaker, 1994), maximum long bone length (Ubelaker, 1989), dental attrition (Brothwell, 1981), cranial suture closure (Meindl and Lovejoy, 1985; Buikstra and Ubelaker, 1994), pubic symphysis morphology and degeneration (Todd, 1920; Gilbert and Mckern, 1973; Katz and Suchey, 1986; Brooks and Suchey, 1990), morphology of the sternal ends of the ribs (Iscan *et al.*, 1984, 1985; Iscan and Loth, 1986), auricular surface degeneration (Lovejoy *et al.*, 1985) and the presence of degenerative joint and dental disease, and osteoporosis.

Ageing juveniles is more accurate and less subjective than ageing adults. By comparing modern rates of dental development and epiphyseal union to development in past populations, a possible age can be inferred. However, this method does assume that the rate of development for past populations is the same as for that of modern populations, even though the quality of the diet, activity loads and living environment determines the rate at which people grow and age (Roberts and Manchester, 1997; Cox, 2000; White, 2000). On the contrary, ageing adults is obscured when full development occurs, generally after 25 years of age as it is impossible to assign a specific age to an individual. The developmental changes associated with particular ages are erased as the person gets older and the impact of occupation, diet, environment, ethnicity, genetic makeup and disease on bone degeneration is also recognised. In addition, females mature by about 1 to 2 years earlier than males, and in general people age at different rates according to their lifestyle (White, 2000). An example of the imprecision of the ageing methods can be observed when the Post-medieval site of Christchurch

Spitalfields is studied. At this site, actual ages were known, however when the skeletal ageing techniques were applied to test the reliance of the methods, different ages were obtained (Molleson and Cox, 1993). To counteract the imprecision of adult aging techniques broad categories of age were used for adults (young adult 16-25, middle adult 26-35, mature adult 36-45, old adult 45 +).

In the results chapter, juvenile information and tables are not divided in subcategories. For the reasons described above, sex distribution of juveniles is impossible to obtain, and age distribution for juveniles is not given, only one category is used (< 16), as most skeletal reports did not present age distribution for juveniles; when they were given, many of the categories differed from those given in other reports and consequently one general group was used to provide continuity and facilitate comparison between periods. Importantly, this problem also accounts for the lack of juvenile information in the research.

6.3.4 Skeletal and Dental Markers of "Stress"

In Chapter Two (Skeletal and Dental Markers of "Stress": Overview) the most frequent methods used to diagnose the skeletal and dental markers of stress studied for this research were described, stature, dental disease (dental caries and enamel hypoplasia), metabolic disease (cribra orbitalia) and tibial periostitis are presented in detail. Data for cribra orbitalia and tibial periostitis were taken in consideration regardless of affecting the skeleton unilaterally or bilaterally as rates for these conditions were calculated by the number of individuals affected and not by the numbers of tibiae affected. The methodology used to collect information on psychological stress consisted simply of identifying modern cases of psychological problems, studying the causes and symptoms of these mental conditions and associating them with problems encountered by the population during the periods studied. It is important to remember that for all the methods described in this chapter and in Chapter Two, limitations are present. Nevertheless, these are the methodologies available to bioarchaeologists now and those used in this research.

6.3.5 Statistical Tests

Quantitative data collected was organised by period and sites in tables and figures where prevalence and mean calculations were performed using the auto functions in Microsoft Office Excel 2003. Prevalence refers to the number of individuals affected in a particular population at a given time (Shennan, 1997). This is calculated by dividing the number of individuals affected by the total in the population. The frequencies were initially taken from the skeletal reports and then the total frequencies and means were calculated by summing of the numbers given. The means were calculated by adding several quantities together and then dividing by the number of quantities (Shennan, 1997; Fletcher and Lock, 2005). (For data included on the table see under the table). Figures were constructed using the data presented in the tables. These descriptive and exploratory methods give only a possible idea that certain similarities or differences were occurring with the data (Robb, 2000). Inferential statistical methods (Chi-square Test and T-Test, see below) were also used to test if any of the information obtained by the descriptive and exploratory methods were statistically significant (Shennan, 1997; Fletcher and Lock, 2005).

To calculate the prevalence of cribra orbitalia and tibial periostitis the number of individuals showing the condition was divided by the total number of individuals observed. For dental caries and enamel hypoplasia, prevalence was calculated with reference to both the total of individuals and the total of teeth affected. The data calculated by individuals affected is needed for statistical analysis and the data obtained from the number of teeth affected is necessary to counteract the possible underestimation of individuals affected by a condition.

To calculate the mean age of death the median for each age category was initially calculated. For the Young adults this became 20, for the Middle Adults 30, for the Mature Adults 40 and for the Old Adults 45 was used. Then for each sex in each period studied, the mean was calculated using the median age of the category. For example, the Romano British females had 4 Young Adults, 34 Middle Adults, 54 Mature Adults and 13 Old Adults. So the following calculations were done:

$$4 \times 20 = 80$$

$$34 \times 30 = 1020$$

$$54 \times 40 = 2160$$

$$13 \times 45 = 585$$

The four totals were then totalled (3845) and then divided by the number of individuals (105). The Mean Age at death was calculated to be 36.6 years.

The statistical tests used to compare the indicators of stress and to determine if the data was statistically significant (significant if calculated there was < 5% chance of the result being produced at random) were the following: Chi-square Test for dental caries, enamel hypoplasia, cribra orbitalia and tibial periostitis (for these conditions actual counts of affected and unaffected individuals were obtained from the skeletal reports which are necessary to do the statistical tests) as well as for age at death to compare the distribution of ages. Mean and standard deviation were used to compare the stature of different groups (male and female) and periods; a T-Test was used to decide if the groups were significantly different in height.

Microsoft Office Excel 2003 was used to calculate the Chi-square Test. This test is used to see if there is a correlation between distributions. The test allows the concept of strength to be applied to the relationship between variables (Shennan, 1997). On the other hand, a T- Test allows comparison of the observed mean to an expected mean. The T-Test assesses whether two groups are statistically different from each other (Shennan, 1997; Fletcher and Lock, 2005). Furthermore, the standard deviation demonstrates how close or far a sample is to the mean; if the value of the standard deviation is small then the samples are close to the mean. In other words, this test reveals how tightly the various examples are clustered around the mean in a set of data (Shennan, 1997; Fletcher and Lock, 2005).

6.3.6 Tables and Figures

As described previously, tables and figures were constructed using Microsoft Office Excel 2003 and all the Figures present data as bar charts. Bar charts are simple visual or graphic representations of numerical data, which facilitate the analysis of results.

(i) Dental Caries and Enamel Hypoplasia

Tables used for dental caries and enamel hypoplasia data (Table 6.2, 6.3 and 6.4) were designed as follows:

	Archaeological site name and author of the skeletal report					
	n	N	%	t	TT	%
M						
F						
U						
J						
TA						
Total						

Table 6.2- Sample Table for dental caries or enamel hypoplasia at (Archaeological site name)
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Site Name	**Period**					
	n	N	%	t	TT	%
Mean Prevalence						

Table 6.3- Sample Table for dental caries or enamel hypoplasia for all (period name) sites.
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA =Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Sites	**Percentages of Individuals or teeth affected by dental caries or enamel hypoplasia**
Roman British Sites	
Early Medieval Sites	
Late Medieval Sites	

Table 6.4- Sample Table for percentage of individuals or teeth affected by dental caries or enamel hypoplasia by period.

(ii) Stature

For the stature data, tables were divided into male and female charts and a further two figures were designed where the comparison of stature by period and sex was presented (Table 6.5, 6.6, and 6.7).

Adult stature	Male or female mean stature	Male or female Minimum stature (m+cm)	Male or female Maximum stature (m+cm)	n=
Site name				
Site name				
Site name				
Site name				
Site name				

Table 6.5- Sample Table for mean male or female stature for all sites with minimum and maximum range (m = metres, cm = centimetres, n = number of male individual used to determine male mean stature).

Periods	Male or Female Mean Height (m+cm)
Romano British Sites	
Early Medieval Sites	
Late Medieval Sites	

Table 6.6- Sample Table for comparison of male or female mean height by period (m = metres, cm = centimetres).

	Female Mean Height (m+cm)	Male Mean Height (m+cm)
Romano British Sites		
Early Medieval Sites		
Late Medieval Sites		
Department of Health 2005		

Table 6.7- Sample Table for comparison of male and female mean height by period (m = metres, cm = centimetres).

(iii) Cribra Orbitalia and Tibial Periostitis

Cribra orbitalia and tibial periostitis data was organised in tables by period, sex and site, and a further two figures were also designed, one where all sites belonging to one period were positioned and another where a comparison of cribra orbitalia or tibial periostitis by period was presented (Table 6.8, 6.9 and Table 6.10). The prevalence of cribra orbitalia and tibial periostitis was considered in terms of the number of individuals affected by these conditions.

	Site Name and Author of skeletal report		
	n	N	%
M			
F			
U			
J			
TA			
Total			

Table 6.8- Sample Table for cribra orbitalia or tibial periostitis at (site name)
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

All sites in one particular period			
	n	N	%

Table 6.9- Sample Table for the prevalence of cribra orbitalia or tibial periostitis for all (period) sites (n = number of individuals affected, N = number of individuals on site, % = percentage of individuals affected).
Note: Blank cells indicate that information was not provided by the skeletal report

Period	**Percentage of Individuals Affected**
Romano-British Sites	
Early Medieval Sites	
Late Medieval Sites	

Table 6.10- Sample Table for the prevalence of cribra orbitalia or tibial periostitis by period

(iv) Age at Death Profile

The age at death profile Tables were adapted from Jakob (2004). The age at death profile is presented in a Table by site and period including each age category and divided by sex. A further two Tables were constructed, one where the age at death profile from all three periods is compared and another where age at death is compared by period and sex (Tables 6.11, 6.12, 6.13).

Site name and author of skeletal report							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*							
Females % %*							
Males % %*							
US % %*							
Total %**							

Table 6.11- Sample Table for Age at Death profile at (site name) or (period) (% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

	Juveniles <16	Young Adults 16-25	Middle Adults 26-35	Mature Adults 36-45	Old Adults 45+	Adults Undetermined Age
Romano-British						
Early medieval						
Late Medieval						

Table 6.12- Sample Table for age at death comparison (all periods)

	Romano-British	Early Medieval	Late Medieval
Female			
Male			
Adults Undetermined Sex			
Combined Adult			

Table 6.13 Sample Table for mean age of death profile comparison for all periods by sex

Chapter 7: Results

7.1 Introduction

In this chapter the results of the data analysis are described. The raw data for every skeletal and dental stress marker studied for each archaeological site are in Appendices D (1-10) and also in CD-ROM format (held in a pocket bound into the back of the thesis). Dental and skeletal data are presented in Tables and Figures by site and period and considered overall by period.

7.2 Dental Caries (DC)

7.2.1 Romano British Dental Caries

Table 7.1-DC shows the prevalence of dental caries for the site of Baldock 1. Unfortunately, the skeletal report (McKinley, 1993) did not give the number and percentage of individuals affected by dental caries. There were 74 males, 50 females, 5 adults of undetermined sex and 62 juveniles excavated from the site. The total number of adults was 129 and the total number of individuals excavated was 191. Two hundred and ninety six teeth of 2806 were affected by dental caries (10.6%).

	Baldock 1, Hertfordshire (McKinley, 1993)					
	n	N	%	t	TT	%
M		74				
F		50				
U		5				
J		62				
TA		129				
Total		191		296	2806	10.6

Table 7.1-DC- Dental caries at Baldock 1, Hertfordshire
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of dental caries for the site of Baldock 3 can be seen in Table 7.2-DC. According to Roberts (1984) the total number of adults studied at this site was 129, of which 42 were affected by dental caries (29.2 %). Nineteen of 45 males were affected (42.2 %). The female rate was 28.6 percent (18 of 63). Five of the 21 adults of undetermined sex were affected (23.8 %).One hundred and two teeth of a total of 1533 had dental caries (6.7 %). Forty five male teeth of 580 had dental caries (7.8 %) of male teeth affected. The prevalence of female teeth affected was slightly higher (8.5 %) or 37 of 438 teeth.

	Baldock 3, Hertfordshire (Roberts, 1984)					
	n	N	%	t	TT	%
M	19	45	42.2	45	580	7.8
F	18	63	28.6	37	438	8.5
U	5	21	23.8		515	
J		15				
TA		129				
Total	42	144	29.2	102	1533	6.7

Table 7.2-DC- Dental Caries at Baldock 3, Hertfordshire
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.3-DC shows the prevalence of dental caries for the site of Colchester, Butt Road. The total number of individuals excavated at this site was 575. No information is provided about the percentage of total individuals affected by dental caries. A frequency rate is given for the males and females. Males (6 of 170), and females (5 of 140) had similar frequencies (3.8 % and 3.9 %, respectively). Two hundred and seventeen teeth of a total of 3665 had dental caries (5.9 %). One hundred and fifty seven male teeth of 1758 had evidence of dental caries (8.9 %) and 4.0 % (60 of 1519 female teeth) were affected by dental caries.

	Colchester, Butt Road, Essex (Pinter-Bellows, 1993)					
	n	N	%	t	TT	%
M	6	170	3.8	157	1758	8.9
F	5	140	3.9	60	1519	4.0
U		157			388	
J		108				
TA		467				
Total	11	575	1.9	217	3665	5.9

Table 7.3-DC- Dental Caries at Colchester, Butt Road, Essex
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of dental caries for the site of the Eastern Cemetery of Roman, London can be found in Table 7.4-DC. The total number of individuals found at this site was 512, and 168 individuals (32.8 %) were affected by dental caries. The prevalence of dental caries for the males was 8.5 % (16 of 186), and 8.2 % (9 of 109) for the females. 7.3% of teeth were affected by dental caries (148 of 2031).

	The Eastern Cemetery of Roman London (Conheeney, 2000a, 2000b)					
	n	N	%	t	TT	%
M	16	186	8.5			
F	9	109	8.2			
U		88				
J		129				
TA		383				
Total	168	512	32.8	148	2031	7.3

Table 7.4-DC- Dental Caries at the Eastern Cemetery of Roman, London
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.5-DC shows the prevalence of dental caries for the site of Winchester, Hampshire. Sixty five of individuals of 375 (17.3 %) were affected by dental caries. One hundred and sixty teeth of 2448 (6.5 %) found at this Romano-British site have evidence of dental caries.

	Winchester, Hampshire (Browne, no date)					
	n	N	%	t	TT	%
M		103				
F		76				
U		42				
J		144				
UA		10				
TA		231				
Total	65	375	17.3	160	2448	6.5

Table 7.5-DC- Dental Caries at Winchester, Hampshire
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, UA= adult of undetermined age, TA =Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Summary of Romano-British dental caries data

Table 7.6 DC and Figure 7.1-DC show the prevalence of dental caries by individuals and teeth affected for all the Romano-British sites. The highest prevalence of dental caries by individual affected is at the site of the Eastern Cemetery of Roman London (32.8 %). This is closely followed by Baldock 3 (29.2 %). The lowest rate is found at Winchester, Hampshire (17.3 %). The sites of Baldock 1 and the site of Colchester, Butt Road provide no data regarding the overall individual prevalence of dental caries.

Site Name	Romano-British Sites					
	n	N	%	t	TT	%
Baldock 1, Hertfordshire		191		296	2806	10.6
Baldock 3, Hertfordshire	42	144	29.2	102	1533	6.7
Colchester, Butt Road, Essex		575		217	3665	5.9
The Eastern Cemetery of Roman London	168	512	32.8		2031	7.3
Winchester, Hampshire	65	375	17.3	160	2448	6.5
Mean Prevalence			26.4			7.4

Table 7.6-DC- Dental Caries for all Romano British Sites
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA =Total Adults,
Note: Blank cells indicate that information was not provided by the skeletal report.

The highest prevalence of teeth affected by dental caries was found at the site of Baldock 1 (10.6 %), followed by the Eastern Cemetery of Roman London (7.3 %). With a prevalence of (6.7 %) the site of Baldock 3 has next the next highest frequency, followed by Winchester, Hampshire (6.5 %). The lowest frequency rate was at Colchester, Butt Road (5.9 %). The mean individual prevalence of dental caries during the Romano-British period was (26.4 %) and the total number of teeth affected was (7.4 %).

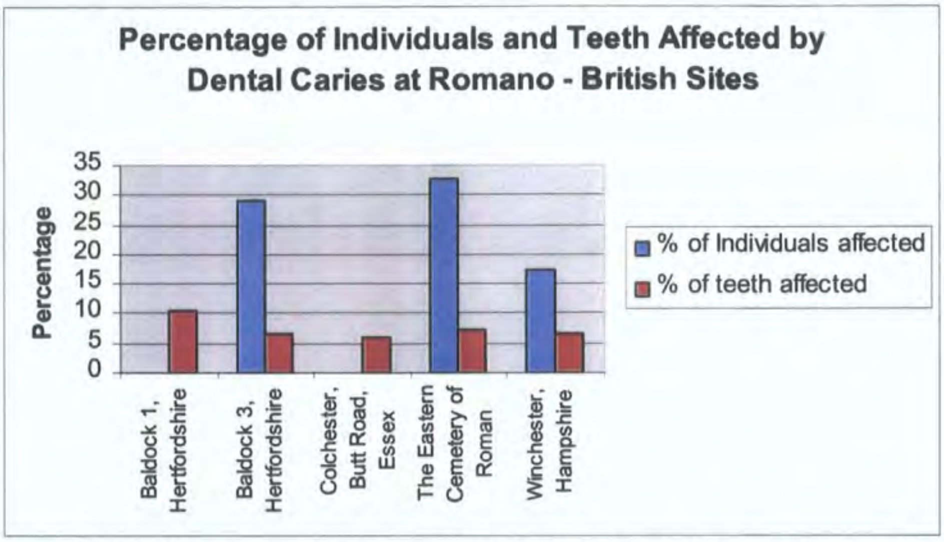


Figure 7.1-DC- Percentage of individuals and teeth affected by dental caries, Romano-British sites.

7.2.2 Early Medieval Dental caries

Table 7.7-DC shows the prevalence of dental caries at the site of Great Chesterford. Fifteen of 167 individuals (9 %) percent of the individuals found at this site had evidence of caries. Four males of 35 were affected by dental caries (11.4 %). The lowest prevalence of caries was found within the female (5.6 % or 11 of 43 females).

	Great Chesterford, Essex (Evison, 1994; Waldron, 1994b)					
	n	N	%	t	TT	%
M	4	35	11.4			
F	11	43	5.6			
U		6				
J		83				
TA	15	167				
Total	15	167	9		1751	

Table 7.7-DC- Dental caries at Great Chesterford, Essex
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of dental caries at the site of Wicken Bonhunt in Essex can be seen in Table 7.8-DC. Forty seven individuals of 222 (21.2 %) were affected by dental caries.

	Wicken Bonhunt, Essex (Hooper, no date)					
	n	N	%	t	TT	%
M	31	94	33	65		
F	16	59	27.1	31		
U		13				
J		56				
TA		166				
Total	47	222	21.2	96	2190	4.4

Table 7.8-DC- Dental caries at Wicken Bonhunt, Essex
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The highest rate is found in the males (33 % or 31 of 94) had evidence of dental caries. The females' frequency rate was (27.1 %). Sixteen females of 59 were affected by this dental condition. Ninety six teeth of 2190 (4.4 %) were affected. Sixty five teeth from male skeletal remains and thirty one teeth from female individuals were affected by dental caries.

Results for dental caries prevalence for the site of Nazeingbury can be seen in Table 7.9-DC. Ten individuals of 154(6.5 %) had caries. Males had a higher rate of dental caries (14.7 %). Five males of 34 have evidence of this dental condition. The female rate was (4.6 %); four females of 88 were affected. Nine adults of 137 (6.6 %) had evidence of dental caries and only 1 of 17 juveniles (5.9 %) was affected.

	Nazeingbury, Essex (Puttnam, 1978)					
	n	N	%	t	TT	%
M	5	34	14.7			
F	4	88	4.6			
U		15				
J	1	17	5.9			
TA	9	137	6.6			
Total	10	154	6.5			

Table 7.9-DC- Dental caries at Nazeingbury, Essex
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.10-DC shows the prevalence of dental caries at the Early Medieval site of Buckland, Dover. Nineteen individuals of 162 (11.7 %) had evidence of dental caries. Seventeen adults of 120 recovered (14.2 %) were affected by this dental disease. The frequency rate for juveniles was (4.8 % or 2 of 42). Sixty seven teeth of 1581 (4.2 %) were affected by caries.

	Buckland, Dover, Kent (Evison, 1987; Powers and Cullen, 1987)					
	n	N	%	t	TT	%
M		54				
F		66				
U	17					
J	2	42	4.8			
TA	17	120	14.2			
Total	19	162	11.7	67	1581	4.2

Table 7.10-DC- Dental caries at Buckland, Dover, Kent
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Dental enamel too eroded to show surface morphology. There were pseudo-caries due to post-mortem erosion. Only the largest dental caries were diagnosed.
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.11-DC shows the prevalence of dental caries at the Early Medieval site of Eccles, Kent. Eighty two teeth of 1424 (5.8 %) were affected by dental caries. Thirty seven male teeth of 771 (4.8 %) had evidence of dental caries. On the other hand (6.9 % or 45 of 653) female teeth had caries.

	Eccles, Kent (Boocock *et al.*, 1995)					
	n	N	%	t	TT	%
M		72		37	771	4.8
F		61		45	653	6.9
U						
J		36				
TA		133				
Total		169		82	1424	5.8

Table 7.11- DC Dental caries at Eccles, Kent
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.12-DC shows the prevalence of dental caries at the site of Staunch Meadow, Brandon. Nineteen individuals of 158 (12.0 %) were affected by dental caries. Six females of 41 (14.6 %) had evidence of dental caries and (14.0 % or 8 of 57 males) were affected. Three of 25 adults of undetermined sex (12 %) showed evidence of this dental condition and (5.7 % or 2 of 35 juveniles) were also affected.

In total, twenty one teeth of 2040 (1.0 %) were affected by dental caries. Six male teeth of 906 (0.7%) had evidence of dental caries and (1.5 % or 11 female teeth of 717) showed signs of this dental condition. Finally, 4 teeth of 417 from adults of undetermined sex (0.01 %) were affected by dental caries.

	Staunch Meadow, Brandon, Suffolk (Anderson, 1990)					
	n	N	%	t	TT	%
M	8	57	14.0	6	906	0.7
F	6	41	14.6	11	717	1.5
U	3	25	12	4	417	0.01
J	2	35	5.7			
TA	17	123	13.8			
Total	19	158	12.0	21	2040	1.0

Table 7.12-DC- Dental caries at Staunch Meadow, Brandon, Suffolk
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The results for the prevalence of dental caries at the site of Edix Hill, Barrington can be seen in Table 7.13-DC. 46 individuals of 148 (31%) were affected. Males (10 of 48) and females (17 of 40) had the following frequency rates (21 % and 43 %, respectively). Four adults of undetermined sex of 14 (25 %) had evidence of this dental condition. In total, 31 adults of 102 (30 %) had evidence of dental caries. As for the number of teeth affected, fifty one teeth of 1600 (3.2 %) had evidence of dental caries.

	Edix Hill, Barrington, Cambridgeshire (Duhig, 1998)					
	n	N	%	t	TT	%
M	10	48	21			
F	17	40	43			
U	4	14	25			
J		46				
TA	31	102	30			
Total	46	148	31	51	1600	3.2

Table 7.13-DC- Dental caries at Edix Hill, Barrington, Cambridgeshire
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.14-DC shows the prevalence of dental caries at the site of North Elmham Park. Forty five individuals of 206 (21.8 %) were affected by dental caries. Male frequency rate

was (29.3 % or 24 of 82 males), and (27.6 % or 21 of 76 females) were affected by dental caries. Forty five adults of 167 (27 %) had evidence of this dental condition. In total, 102 teeth of 1819 (5.6 %) had dental caries. Fifty three male teeth of 778 and 49 female teeth of 799 (6.1 %) were affected by dental caries.

	North Elmham Park, Norfolk (Wells and Cayton, 1980)					
	n	N	%	t	TT	%
M	24	82	29.3	53	778	6.8
F	21	76	27.6	49	799	6.1
U		9				
J		39			242	
TA	45	167	27			
Total	45	206	21.8	102	1819	5.6

Table 7.14-DC- Dental caries at North Elmham Park, Norfolk
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.15-DC shows the prevalence of dental caries at the site of Burgh Castle. Nineteen individuals of 197 (9.6 %) were affected by dental caries. Fourteen males of 79 (17.2 %) and 5 females of 64 (7.8 %) had dental caries. Interestingly, 19 adults of 167 (11.4 %) were affected by this dental condition. Twenty five teeth of 1347 (1.9 %) showed changes associated to dental caries. The number of male teeth affected by this dental condition was 18 of 793 (2.3 %) and (7 of 554 female teeth or 1.3 %) had caries.

	Burgh Castle, Norfolk (Anderson and Birkett, 1991, 1993)					
	n	N	%	t	TT	%
M	14	79	17.7	18	793	2.3
F	5	64	7.8	7	554	1.3
U		24				
J		30				
TA	19	167	11.4			
Total	19	197	9.6	25	1347	1.9

Table 7.15-DC- Dental caries at Burgh Castle, Norfolk
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Summary of Early Medieval dental caries data

Table 7.16-DC and Figure 7.2-DC show the prevalence of dental caries by individuals and teeth affected for all the Early Medieval sites. During this period, the site of Edix Hill has the highest rate of dental caries by individuals affected (31 %), followed by North Elmham Park (21.8 %). At Wicken Bonhunt the rate was (21.2 %) and at Staunch Meadow was (12.0 %). With a rate of 11.73 percent the site of Buckland, Dover in Kent is next. The rate at Burgh Castle is the first less than 10% (9.6 %), closely followed (9 %) at Great Chesterford. The lowest rate of individuals affected was at Nazeingbury (6.5 %).

Site Name	Early Medieval Sites					
	n	N	%	t	TT	%
Great Chesterford, Essex	15	167	9.0		1751	
Wicken Bonhunt, Essex	47	222	21.2	96	2190	4.4
Nazeingbury, Essex	10	154	6.5			
Buckland, Dover, Kent	19	162	11.7	67	1581	4.2
Eccles, Kent		133		82	1424	5.8
Staunch Meadow, Brandon, Suffolk	19	158	12.0	21	2040	1.0
Edix Hill, Barrington, Cambridgeshire		148	31	51	1600	3.2
North Elmham Park, Norfolk	45	206	21.8	102	1819	5.6
Burgh Castle, Norfolk	19	197	9.6	25	1347	1.9
Mean Prevalence			15.4			3.10

Table 7.16-DC- Prevalence of dental caries for all Early Medieval sites
(n = number of individuals affected, N = number of individuals on site, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site).
Note: Blank cells indicate that information was not provided by the skeletal report.

As for the percentage of teeth affected by dental caries the site of Eccles, Kent had the highest prevalence of teeth affected (5.8 %), closely followed by (5.6 %) at the site of North Elmham Park. The sites of Wicken Bonhunt and the site of Buckland, Dover have rates of 4.4 % and 4.2 %, respectively; at Edix Hill, Barrington in Cambridgeshire 3.2 % of the teeth had caries and only 1.9 % of teeth at Burgh Castle. The lowest prevalence of dental caries is from Staunch Meadow, Brandon (1.0 %). The mean prevalence of dental caries by individuals affected during the Early Medieval period is 15.4 % and the total rate of dental caries by teeth affected is 3.1 %.

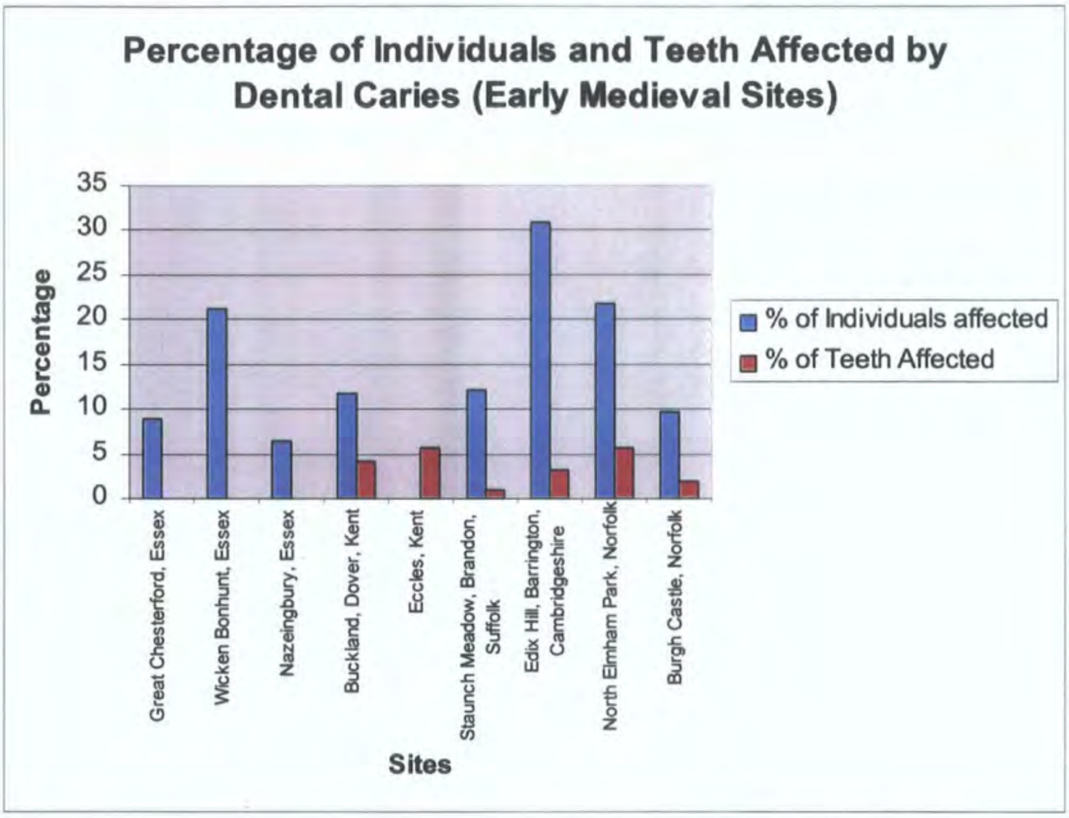


Figure 7.2-DC- Percentage of individuals and teeth affected by dental caries, Early Medieval Sites.

7.2.3 Late Medieval Dental Caries

Table 7.17-DC shows the prevalence of dental caries by individuals and teeth affected at the site of Blackfriars Friary. One hundred and sixteen individuals of 250 (46.4 %) were affected by dental caries. Forty females of 64 (62.5 %) and 76 males of 148 (51.4 %) had evidence of this dental condition. One hundred and sixteen adults of 226 adults (51.3 %) had changes associated with dental caries. Finally, Three hundred and one teeth of 2893 (10.4 %) were affected by dental caries. Ninety nine female teeth of 854 (11.6 %) and 202 male teeth of 2039 (9.9 5%) had evidence of dental caries.

	Blackfriars Friary, Ipswich, Suffolk (Mays, 1991)					
	n	N	%	t	TT	%
M	76	148	51.4	202	2039	9.9
F	40	64	62.5	99	854	11.6
U		14				
J		24				
TA	116	226	51.3			
Total	116	250	46.4	301	2893	10.4

Table 7.17-DC- Dental caries at Blackfriars Friary, Ipswich in Suffolk
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.18-DC shows the prevalence of dental caries at the site of St James and St Mary Magdalene Hospital. Two hundred and one individuals of 384 (52.3 %) were affected by this dental condition. Fifty four females of 75 (72.0 %) and 123 males of 191 (64.4 %) had evidence of dental caries. Also, twenty four juveniles of 100 (24.0 %) had caries. One hundred and seventy seven adults of 284 (62.3 %) were affected.

Six hundred and eighty four teeth of 4344 (15.8 %) showed evidence of dental caries. Two hundred and twenty seven female teeth of 1076 (21.1 %) and 420 male teeth of 2826 (14.9 %) were affected by this dental condition. Also, 37 adults of undetermined sex teeth of 442 (8.4 %) were affected.

	St James and St Mary Magdalene Hospital, Chichester, Sussex (Lee and Magilton, 1989; Magilton and Lee, 1989)					
	n	N	%	t	TT	%
M	123	191	64.4	420	2826	14.9
F	54	75	72.0	227	1076	21.1
U		18		37	442	8.4
J	24	100	24.0			
TA	177	284	62.3			
Total	201	384	52.3	684	4344	15.8

Table 7.18-DC- Dental caries at St James and St Mary Magdalene Hospital, Chichester, Sussex
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Dental caries prevalence by individuals and teeth affected in the site of Royal Mint, St Mary Graces Priory in London can be seen in Table 7.19-DC. Unfortunately, dental pathology was not included in the skeletal report.

	Royal Mint, St Mary Graces Priory, London (Waldron, 1993)					
	n	N	%	t	TT	%
M		376				
F		249				
U		65				
J		244				
TA		690				
Total		934				

Table 7.19-DC- Dental caries at Royal Mint, St Mary Graces Priory, London
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of dental caries at the site of St. Nicholas Shambles can be seen in Table 7.20-DC. Thirty five individuals of 234 (15.0 %) had evidence of dental caries. Nineteen females of 77 (24.7 %) and 16 males of 90 (17.8 %) were affected by this dental condition. The total number of adults found at this archaeological site is 188 adults, 35 or 18.6 % were affected by dental caries. Sixty seven teeth of 790 (8.5 %) had changes associated with dental caries. Thirty one male teeth of 344 (9.0 %) and 36 female teeth of 446 (8.1 %) were affected by dental caries.

	St. Nicholas Shambles, London (White, 1988)					
	n	N	%	t	TT	%
M	16	90	17.8	31	344	9.0
F	19	77	24.7	36	446	8.1
U		21				
J		46				
TA	35	188	18.6			
Total	35	234	15.0	67	790	8.5

Table 7.20-DC- Dental caries at St. Nicholas Shambles, London
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.21-DC presents the prevalence of dental caries by individuals and teeth affected at the site of Spitalfields Market. Ninety five individuals of 200 (47.5 %) were affected by dental caries. Forty five females of 76 (59.2 %) and 45 males of 83 (54.2 %) had evidence of caries. Also, five adults of undetermined sex of 9 (55.6 %) were affected. Ninety five adults of 168 (56.6 %) found at this site had evidence of dental caries.

Two hundred and ninety one teeth of 3159 (9.2 %) had changes associated with dental caries. One hundred and twenty one male teeth of 1315 (9.2 %) and 152 female teeth of 1101 (13.8 %) were affected. It is relevant to note that the skeletal report by Connell (2002) does not give information about 743 teeth of the total of 3159 teeth found at this site. Also, 18 teeth that are affected by dental caries are not placed in any of the categories (male, female, adults of undetermined sex and juveniles) under study.

	Spitalfields Market, London (Connell, 2002; Conheeney, 1997)					
	n	N	%	t	TT	%
M	45	83	54.2	121	1315	9.2
F	45	76	59.2	152	1101	13.8
U	5	9	55.6			
J		32				
TA	95	168	56.6			
Total	95	200	47.5	291	3159	9.2

Table 7.21-DC- Dental caries at Spitalfields Market, London
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.22-DC shows the prevalence of dental caries by individual and teeth affected at the site of Thetford, Norfolk. Twenty four individuals of 149 (16.1 %) were affected by dental caries. Nine males of 19 (47.4 %) and 7 females of 21 (33.3 %) had evidence of this dental condition. Also, six juveniles of 62 (9.7 %) and Two adults of undetermined sex of 47 (4.3 %) showed evidence of this pathological condition. In total, 18 adults of 87 (20.7 %) were affected. Seventy eight teeth of 1286 (6.1 %) had evidence of caries. Molars were more affected than incisors and canines (Stroud, 1993).

	Thetford, Norfolk (Stroud, 1993)					
	n	N	%	t	TT	%
M	9	19	47.4			
F	7	21	33.3			
U	2	47	4.3			
J	6	62	9.7			
TA	18	87	20.7			
Total	24	149	16.1	78	1286	6.1

Table 7.22-DC- Dental caries at Thetford, Norfolk
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.23-DC shows the prevalence of dental caries by individual and teeth affected at the site of Stratford Langthorne Abbey. Interestingly, White (1999:12) mentions that dental caries prevalence is very low at this site, and it is comparable to Early Medieval levels instead of Late Medieval rates, however, no specific rate is provided in the skeletal report to demonstrate this low prevalence.

	Stratford Langthorne Abbey, Essex (White, 1999; Stuart-Macadam ,1985b, 1986)					
	n	N	%	t	TT	%
M		536		288	7106	4.1
F		28				
U		55				
J		28				
TA		619				
Total		647		288	7181	4.0

Table 7.23-DC- Dental caries at Stratford Langthorne Abbey, Essex
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Two hundred and eighty eight teeth of 7181 (4.0 %) were affected by dental caries. It is important to mention that all the teeth recovered were from male skeletal remains, no teeth from female individuals were found.

Summary of Late Medieval dental caries data

Table 7.24-DC and Figure 7.3-DC show the prevalence of dental caries by individuals and teeth affected for all the Late Medieval sites studied. The highest rate of caries by individuals affected was at St. James and St. Mary Magdalene Hospital, Chichester (52.3 %), followed by Spitalfields Market (47.5 %). This is closely followed by 46.4 % at

Blackfriars Friary, Ipswich. The sites of Thetford and St. Nicholas Shambles have the lowest rate of caries (16.1 % and 15.0 %, respectively).

Site Name	**Late Medieval Sites**					
	n	N	%	t	T	%
Blackfriars Friary, Ipswich, Suffolk	116	250	46.4	301	2893	10.4
St. James and St Mary Magdalene Hospital, Chichester, Sussex	201	384	52.3	684	4344	15.8
Royal Mint, St Mary Graces Priory, London						
St. Nicholas Shambles, London	35	234	15.0	67	790	8.5
Spitalfields Market, London	95	200	47.5	291	3159	9.2
Thetford, Norfolk	24	149	16.1	78	1286	6.1
Stratford Langthorne Abbey, Essex		647		288	7181	4.0
Mean Prevalence			30.0			9.0

Table 7.24-DC- Prevalence of individuals and teeth affected by dental caries in the Late Medieval Sites (n = number of individuals affected, N = number of individuals on site, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence rate for caries of teeth affected is highest at St. James and St. Mary Magdalene Hospital, Chichester (15.8 %). Blackfriars Friary, Ipswich has a rate of 10.4 %, followed by Spitalfields Market (9.2 %), closely followed by St. Nicholas Shambles (8.5 %). Only 6.1 % of the teeth recovered at Thetford were affected by dental caries. During this period, the lowest rate of teeth affected was found at Stratford Langthorne Abbey (4.0 %). The mean prevalence of individuals and teeth affected by dental caries during the Late Medieval period is 30 % and 9.0 %, respectively.

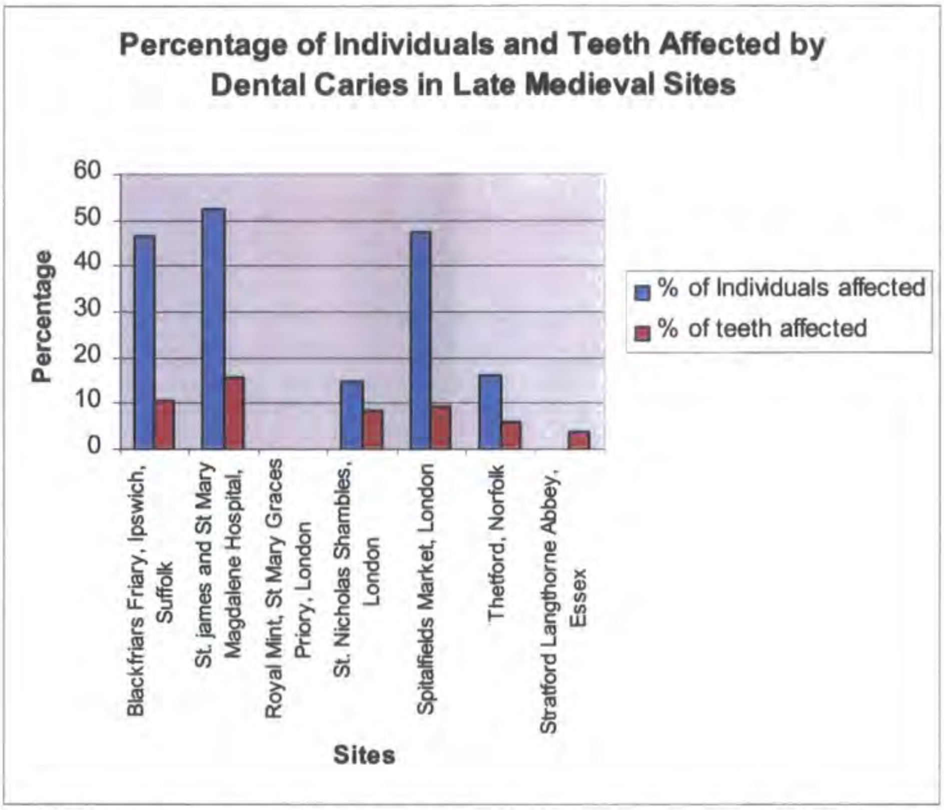


Figure 7.3-DC- Percentage of individuals and teeth affected by dental caries, Late Medieval sites

7.2.4 Dental Caries: All periods

Figures 7.4-DC shows the prevalence rates for individuals and teeth affected by dental caries in all sites, from each period (Romano-British, Early Medieval and Late Medieval). The best way to calculate the prevalence of dental disease in a population is by knowing the number of teeth observed so that caries prevalence as a percentage of the number of teeth can be estimated. Introducing prevalence of dental disease per individual assumes that all the teeth were preserved or that the teeth lost were not affected by dental disease (Roberts and Manchester, 2005:66). In this research data is presented by individual and teeth affected. Of the total of 21 sites studied, only 16 presented information regarding the prevalence of dental caries by individuals affected (five Romano-British, nine Early Medieval, and seven Late Medieval sites). The highest prevalence for dental caries by individuals affected was at St. James and St. Mary Magdalene Hospital, Chichester in

Sussex (52.3 %) and Spitalfields Market (47.5 %), both Late Medieval sites. These rates are closely followed by that of the Late Medieval site of Blackfriars Friary, Ipswich (46.4 %). This is followed by the Romano-British site of The Eastern Cemetery of Roman London (32.8 %), and Early Medieval site of Edix Hill, Barrington (30.9 %).

Baldock 3 (29.2 %) is the first site with a dental caries rate under 30 % (Romano-British). The Early Medieval site of North Elmham Park in Norfolk is next with a rate of 21.8%, closely followed by the Early Medieval site of Wicken Bonhunt (21.2 %). The first site with a rate under 20 % is the Romano-British site of Winchester (17.3 %), followed by the site of Thetford (16.1 %) and the site of St. Nicholas Shambles (15.0 %), both Late Medieval sites. The rate for the Early Medieval site of Staunch Meadow, Brandon is 14.6 %. Another Early Medieval site, Buckland, Dover, follows with (11.4 %).The first site with a rate under 10 % is the Early Medieval site of Burgh Castle (9.6%). This is closely followed by the Early Medieval site of Great Chesterford (9.0 %) The lowest rate by individuals affected is from the Early Medieval site of Nazeingbury (6.5 %).

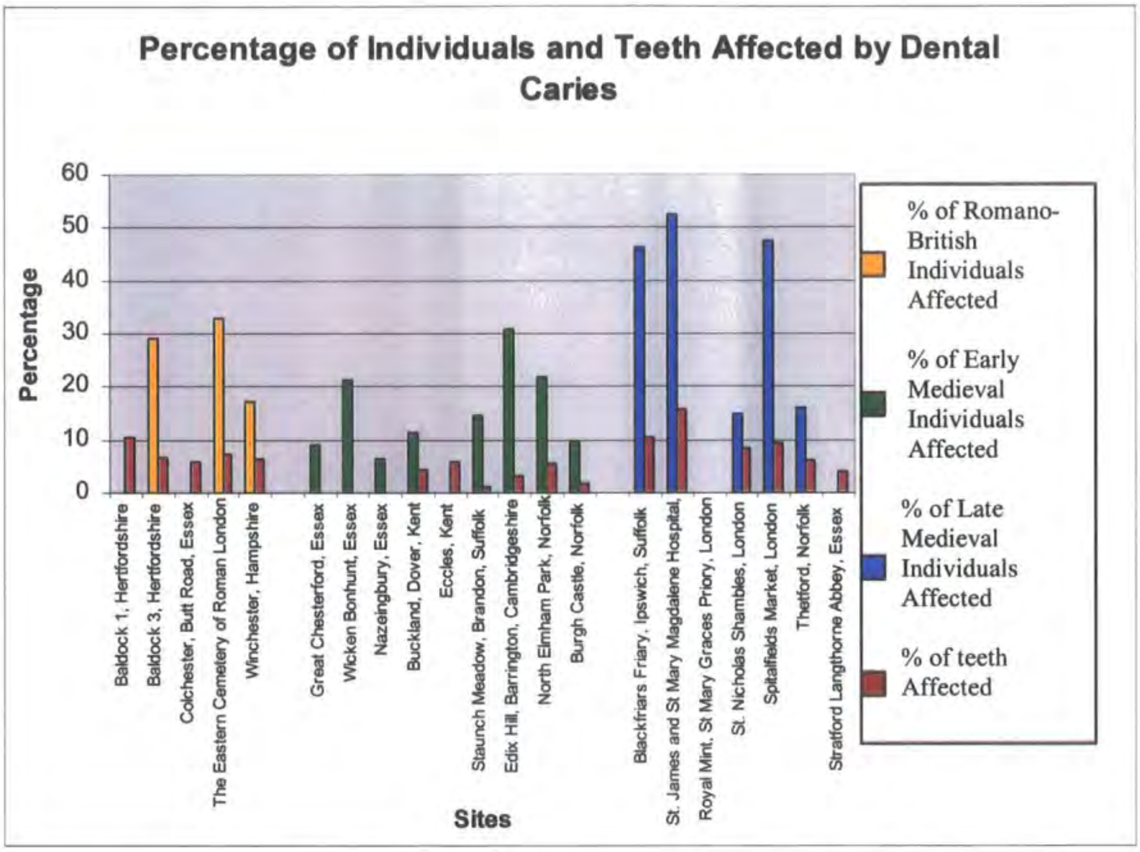


Figure 7.4-DC- Percentage of Individuals and Teeth Affected by Dental Caries in all sites.

Of the 21 skeletal reports studied, 18 give information concerning the prevalence of dental caries by teeth affected. Figure 7.4-DC show that the highest rate of caries at the Late Medieval site of St. James and St. Mary Magdalene Hospital, Chichester (15.8 %), followed by the Romano-British site of Baldock 1 (10.6 %). At the Late Medieval site of Blackfriars Friary, Ipswich the rate is 10.4 %. Two Late Medieval sites come next with a rate of 9.2 % and 8.5 % (Spitalfields Market and St. Nicholas Shambles, respectively). The Romano-British site of The Eastern Cemetery of Roman London follows with a rate of 7.3 %.

The Romano-British site of Baldock 3 in Hertfordshire has a prevalence rate of 6.7 %, closely followed by Romano-British site of Winchester (6.5 %). The Late Medieval site of

Thetford in Norfolk comes next (6.1 %), followed by the Romano-British site of Colchester (5.9 %). Four Early Medieval sites are next most affected: Eccles (5.8 %), North Elmham Park (5.6 %), Wicken Bonhunt (4.4 %) and Buckland, Dover (4.2 %). The Late Medieval site of Stratford Langthorne Abbey follows with a rate of 4.0 % and the Early Medieval site of Edix Hill with a rate of 3.2 %.The lowest prevalence rate of caries by teeth affected was found at two Early Medieval sites, Burgh Castle (1.9 %) and Staunch Meadow, Brandon (1.0 %). For a separate and detailed graphic indication of the prevalence of dental caries by individuals and teeth affected at each archaeological site see Figure 7.5-DC and Figure 7.6-DC.

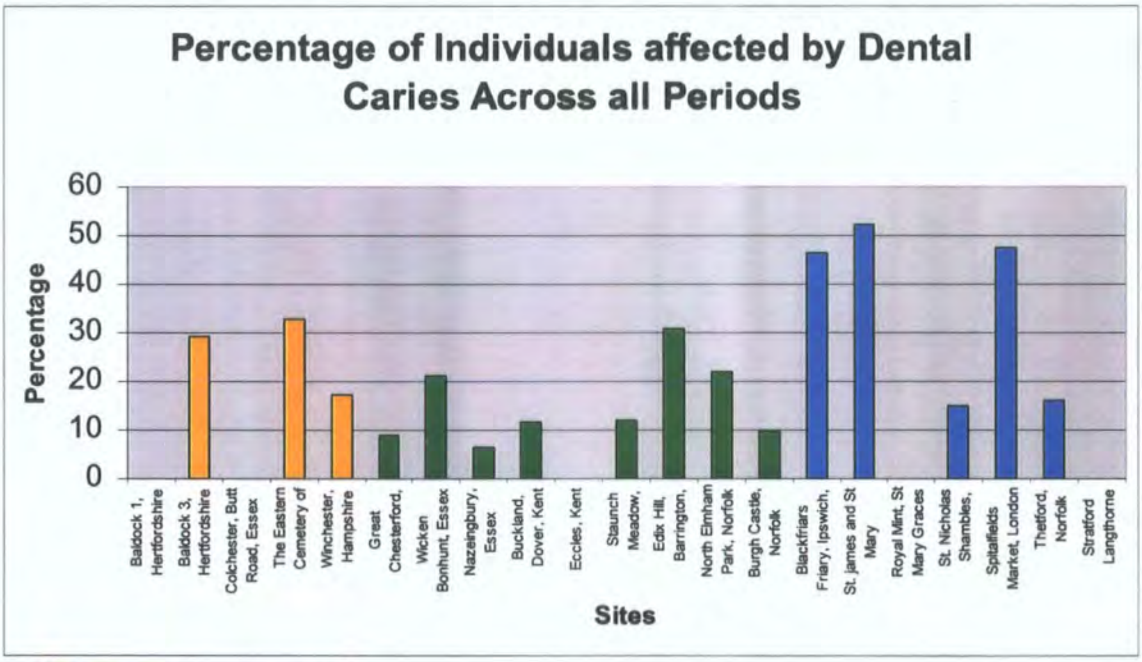
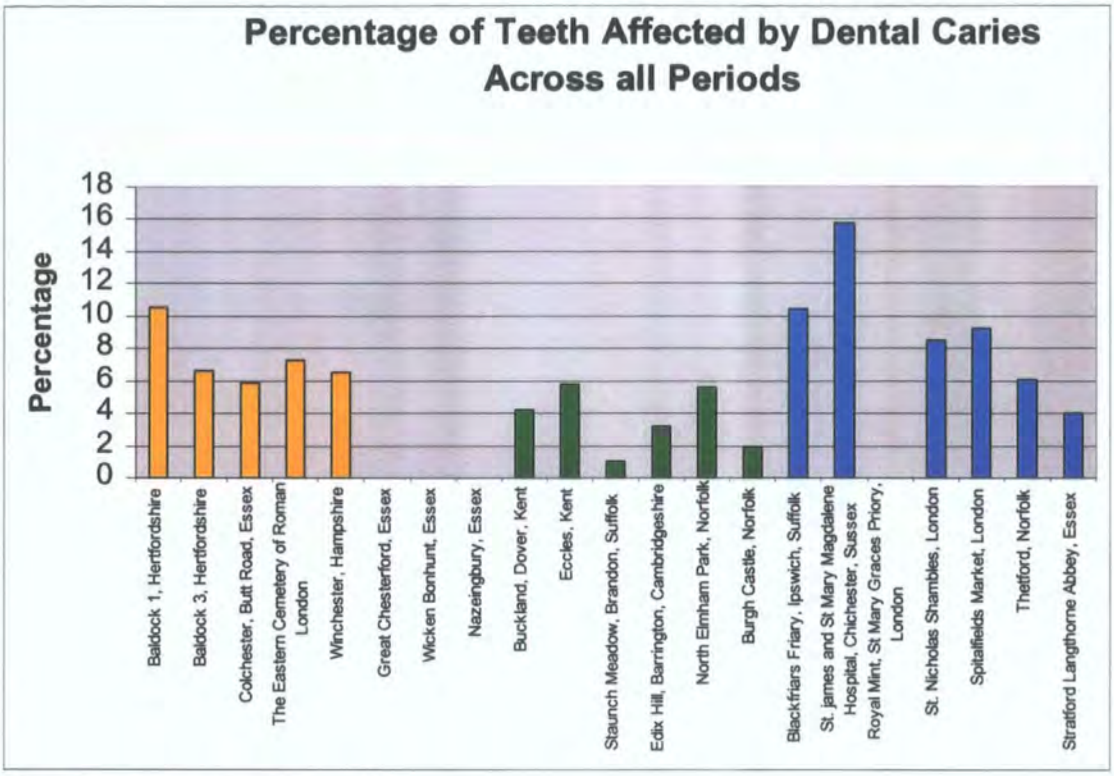


Figure 7.5-DC- Prevalence of individuals affected by dental caries in all sites.



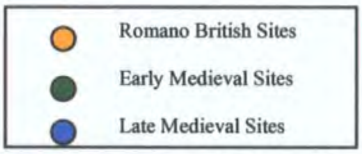


Figure 7.6-DC- Prevalence of teeth affected by dental caries in all sites.

Table 7.25-DC and Figure 7.7-DC shows the overall prevalence rate of dental caries by individuals affected for all the periods studied. The highest prevalence rate of caries is found within the Late Medieval period (35.5 % of individuals). The prevalence of dental caries by individuals from Romano-British period is (26.4 %), and the lowest rate is found within the Early Medieval period with 15.6 %. The dental caries distribution by individuals affected was significantly different between the Romano-British period and the Early Medieval period ($X^2 = 18.589$, $p<0.001$, d.f. = 1) and statistically significant between the Early Medieval period and the Late Medieval period ($X^2 = 50.771$, $p<0.001$, d.f. = 1). Differences in dental caries prevalence by individuals affected between the three periods were also found to be statistically significant ($X^2 = 50.5987$, $p<0.001$, d.f. = 2).

Sites	% of Individuals Affected
Roman British Sites	26.4
Early Medieval Sites	15.4
Late Medieval Sites	35.5

Table 7.25-DC- Percentage of individuals affected by dental caries by period

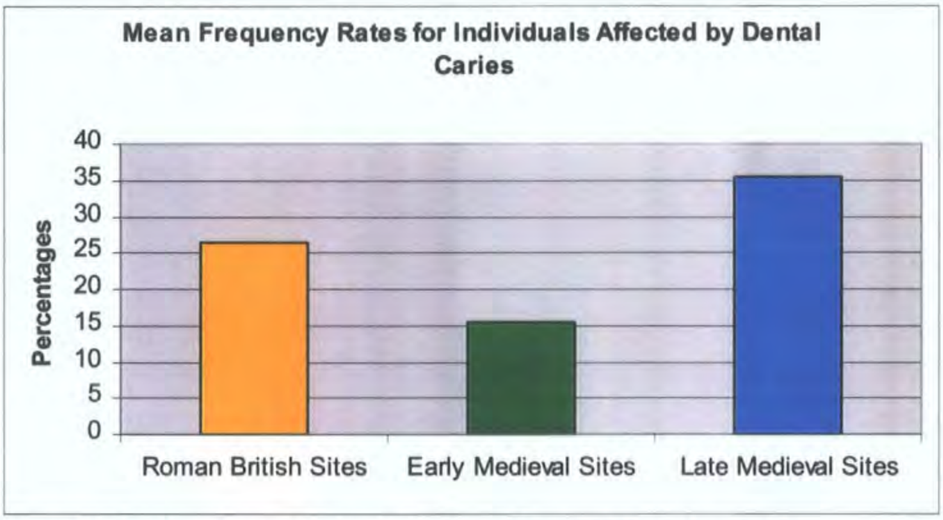


Figure 7.7-DC- Prevalence of individuals affected by dental caries by period.

Table 7.26-DC shows the overall prevalence rate of teeth affected by dental caries during all the periods under study. The highest rate of caries by teeth affected can be found during the Late Medieval period (9.0 %). The Romano-British period is next with a rate of 7.4%.The lowest rate of caries by teeth affected is in the Early Medieval period (3.1 %). The teeth affected by dental caries for all the periods under study can be seen in Figure 7.8-DC. The dental caries distribution by teeth affected was significantly different between the Romano-British period and the Early Medieval period ($X^2 = 131.14$, $p<0.001$, d.f. = 1) and statistically significant between the Early Medieval period and the Late Medieval period ($X^2 = 401.072$, $p<0.001$, d.f. = 1). Differences in dental caries prevalence by teeth affected between the three periods were also found to be statistically significant ($X^2 = 405.6932$, $p<0.001$, d.f. = 2).

Sites	% of Teeth Affected
Roman British Sites	7.4
Early Medieval Sites	3.1
Late Medieval Sites	9.0

Table 7.26-DC- Percentage of teeth affected by dental caries by period

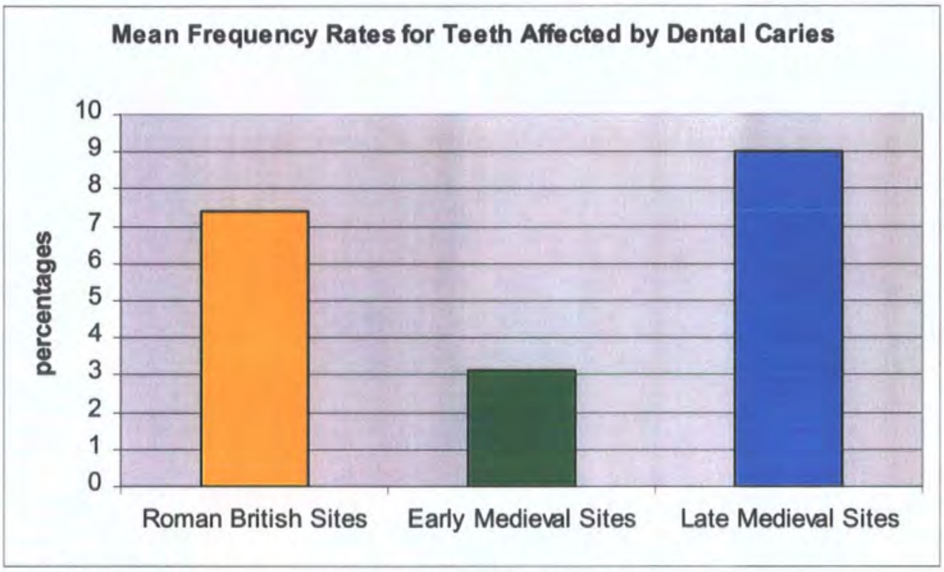


Figure 7.8-DC- Prevalence of teeth affected by dental caries by period

7.3 Enamel Hypoplasia (EH)

7.3.1 Romano-British – Enamel Hypoplasia

Table 7.1-EH shows the percentage of enamel hypoplasia at the site of Baldock1. Twelve individuals of 191 (6.3 %) were affected by enamel hypoplasia. Seven males of 74 (9.5 %), and three females of 50 (6.0 %) had evidence of this dental condition. Also, two adults of undetermined sex of 5 (4.0 %) were affected. In total, 12 adults of 129 (9.3%) had enamel hypoplasia.

	Baldock 1, Hertfordshire (McKinley, 1993)					
	n	N	%	t	TT	%
M	7	74	9.5			
F	3	50	6.0			
U	2	5	4.0			
J		62				
TA	12	129	9.3			
Total	12	191	6.3		2806	

Table 7.1-EH- Enamel hypoplasia at Baldock 1, Hertfordshire
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.2-EH gives the prevalence of enamel hypoplasia at the site of Baldock 3. Thirty three individuals of 144 (22.9 %) had changes associated with enamel hypoplasia. Interesting, males and adults of undetermined sex showed similar rate (33.3 %), fifteen males of 45, and 7 adults of undetermined sex of 21 were affected. Eleven females of 63 (17.5 %) had enamel hypoplasia. In total, 33 adults of 129 (25.6 %) had enamel hypoplasia. Seventy nine teeth of 1533 (5.2 %) were affected.

	Baldock 3, Hertfordshire (Roberts, 1984)					
	n	N	%	t	TT	%
M	15	45	33.3		580	
F	11	63	17.5		438	
U	7	21	33.3		515	
J		15			0	
TA	33	129	25.6		0	
Total	33	144	22.9	79	1533	5.2

Table 7.2-EH- Enamel hypoplasia at Baldock 3, Hertfordshire
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.3-EH shows the prevalence of enamel hypoplasia at the site of Colchester, Butt Road. Sixty four individuals of 575 (11.1 %) were affected by enamel hypoplasia. Twenty

four females of 140 (17.1 %) and twenty five males of 170 (14.7) had evidence of this dental condition. Only 2 adult of undetermined sex of 157 (1.3 %) were affected. In total 51 adults of 467 (10. 9 %) had enamel hypoplasia and Thirteen juveniles of 108 (12.0 %) were affected.

	Colchester, Butt Road, Essex (Pinter-Bellows, 1993)					
	n	N	%	t	TT	%
M	25	170	14.7		1758	
F	24	140	17.1		1519	
U	2	157	1.3		388	
J	13	108	12.0			
TA	51	467	10.9			
Total	64	575	11.1		3665	

Table 7.3-EH- Enamel hypoplasia at Colchester, Butt Road, Essex
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of enamel hypoplasia for the site The Eastern Cemetery of Roman London can be observed in Table 7.4-EH. Two hundred and ninety five individuals of 512 (57.6 %) were affected by enamel hypoplasia. Twelve females of 109 (11.0 %), and 16 males of 186 (8.5 %) were affected. Two hundred and forty two teeth of 2031 (11.9 %) had evidence of enamel hypoplasia.

	The Eastern Cemetery of Roman London, London (Conheeney, 2000a, 2000b)					
	n	N	%	t	TT	%
M	16	186	8.5			
F	12	109	11.0			
U		88				
J		129				
TA		383				
Total	295	512	57.6	242	2031	11.9

Table 7.4-EH- Enamel hypoplasia at The Eastern Cemetery of Roman London
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

At the site of Winchester (Table 7.5-EH) twenty seven individuals of 375 (7.2 %) were affected by enamel hypoplasia. No other information is given in the skeletal report concerning enamel hypoplasia.

	Winchester, Hampshire (Browne, no date)					
	n	N	%	t	TT	%
M		103				
F		76				
U		42				
J		144				
UA		10				
TA		231				
Total	27	375	7.2		2448	

Table 7.5-EH- Enamel hypoplasia at Winchester, Hampshire
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, UA = undetermined age, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report

Summary of Romano-British enamel hypoplasia data

Table 7.6-EH shows the prevalence of enamel hypoplasia by individuals and teeth affected for all the Romano-British sites studied. The highest rate was found at the Eastern Cemetery of Roman London in London (57.6 %), followed by Baldock 3 (22.9 %). The site of Colchester, Butt Road comes next with a rate of 11.1 %, and at Winchester the rate was 7.2 %. The lowest rate was found at Baldock 1 (6.3 %). The graphical indication of the prevalence of enamel hypoplasia can be found in Figure7.1-EH.

Site Name	Romano British Site Totals					
	n	N	%	t	T	%
Baldock 1, Hertfordshire	12	191	6.3		2806	
Baldock 3, Hertfordshire	33	144	22.9	79	1533	5.2
Colchester, Butt Road, Essex	64	575	11.1		3665	
The Eastern Cemetery of Roman London	295	512	57.6	242	2031	11.9
Winchester, Hampshire	27	375	7.2		2448	
Mean Prevalence			21.0			8.5

Table 7.6-EH- Prevalence of enamel hypoplasia in all Romano-British sites
(n = number of individuals affected, N = number of individuals on site, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site.
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of teeth affected by enamel hypoplasia was highest at the Eastern Cemetery of Roman London (11.9 %), followed by Baldock 3 (5.2%).The mean prevalence of individuals and teeth affected by enamel hypoplasia during the Romano-British period is 21.03 percent and 8.53 percent respectively.

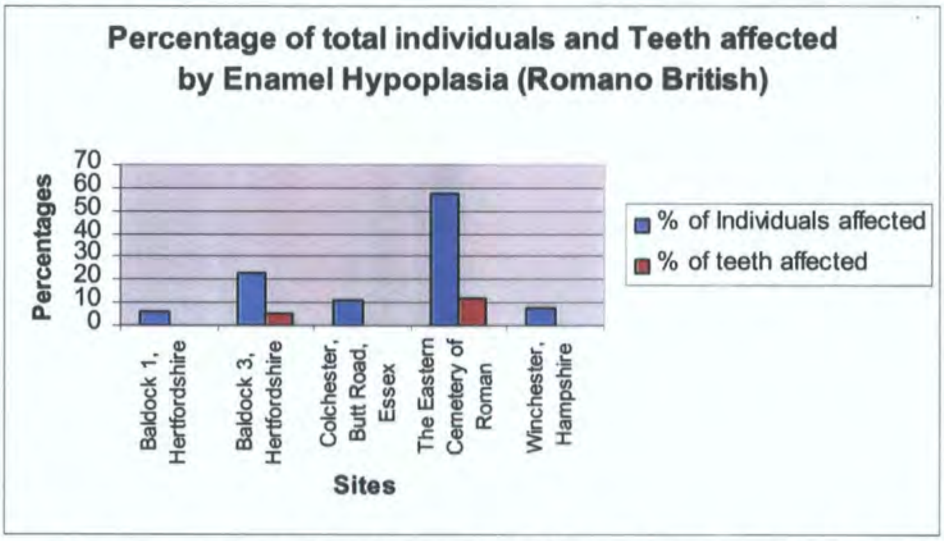


Figure 7.1-EH- Percentage of individuals and teeth affected by enamel hypoplasia, Romano-British sites.

7.3.2 Early Medieval Enamel hypoplasia

Table 7.7-EH shows the prevalence of enamel hypoplasia at the site of Great Chesterford, Essex; however, no information concerning enamel hypoplasia was given in the skeletal report.

	Great Chesterford, Essex (Evison, 1994; Waldron, 1994b)					
	n	N	%	t	TT	%
M		35				
F		43				
U		6				
J		83				
TA		167				
Total		167			1751	

Table 7.7-EH- Enamel hypoplasia at Great Chesterford, Essex
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.8-EH displays the prevalence of enamel hypoplasia at the site of Wicken Bonhunt; however, no information concerning enamel hypoplasia was given in the skeletal report.

	Wicken Bonhunt, Essex (Hooper, no date)					
	n	N	%	t	TT	%
M		94				
F		59				
U		13				
J		56				
TA		166				
Total		222			2190	

Table 7.8-EH- Enamel hypoplasia at Wicken Bonhunt, Essex
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.9-EH shows the prevalence of enamel hypoplasia at the site of Nazeingbury, Essex. Twenty one individuals of 154 (13.6 %) were affected by enamel hypoplasia. Seventeen juveniles of 17 (100 %) showed evidence of this dental condition.

Two males of 34 (5.9 %) and two females of 88 (2.3 %) were affected.

	Nazeingbury, Essex (Puttnam, 1978)					
	n	N	%	t	TT	%
M	2	34	5.9			
F	2	88	2.3			
U		15				
J	17	17	100			
TA		137				
Total	21	154	13.6			

Table 7.9-EH- Enamel hypoplasia at Nazeingbury, Essex
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.10-EH displays the prevalence of enamel hypoplasia at the site of Buckland, Dover; however, no information concerning enamel hypoplasia was given in the skeletal report.

	Buckland, Dover, Kent (Evison, 1987; Powers and Cullen, 1987)					
	n	N	%	t	TT	%
M		54				
F		66				
U						
J		42				
TA		120				
Total		162			1581	

Table 7.10-EH- Enamel hypoplasia at Buckland, Dover, Kent
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults)
Note: Dental enamel too eroded to show surface morphology.
Note: Blank cells indicate that information was not provided by the skeletal report.

The site of Eccles, Kent (Table 7.11-EH) had a rate of enamel hypoplasia of 25.4 % (43 individuals of 169). Twenty four males of 72 (33.3 %) and nineteen females of 61 (31.2 %) were affected by enamel hypoplasia.

	Eccles, Kent (Boocock *et al.*, 1995)					
	n	N	%	t	TT	%
M	24	72	33.3		771	
F	19	61	31.2		653	
U						
J		36				
TA		133				
Total	43	169	25.4		1424	

Table 7.11-EH- Enamel hypoplasia at Eccles, Kent
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

The site of Staunch Meadow, Brandon (Table 7.12-EH) had a total prevalence of enamel hypoplasia of 36.1 % (57 individuals of 158). Twenty eight males of 57 (49.1 %), and sixteen females of 41 (39.0 %) showed evidence of enamel hypoplasia. Also, Six adults of undetermined sex of 25 (24.0 %), and 7 juveniles of 35 (20.0 %) were affected. Fifty adults of 123 (40.7 %) had enamel hypoplasia.

	Staunch Meadow, Brandon, Suffolk (Anderson, 1990)					
	n	N	%	t	TT	%
M	28	57	49.1		906	
F	16	41	39.0		717	
U	6	25	24.0			
J	7	35	20.0			
UA					417	
TA	50	123	40.7			
Total	57	158	36.1		2040	

Table 7.12-EH- Enamel hypoplasia at Staunch Meadow, Brandon, Suffolk
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.13-EH shows the prevalence of enamel hypoplasia at the site of Edix Hill, Barrington. Sixteen individuals of 148 (10.8 %) had enamel hypoplasia. Nine males of 48

(18.8 %) and five females of 40 (12.5 %) were affected by this dental condition. Two juveniles of 46 were affected (4.4 %), and eighty one teeth of 1600 (4.0 %) showed evidence of enamel hypoplasia.

	Edix Hill, Barrington, Cambridgeshire (Duhig, 1998)					
	n	N	%	t	TT	%
M	9	48	18.8			
F	5	40	12.5			
U		14				
J	2	46	4.4			
TA		102				
Total	16	148	10.8	81	1600	4.0

Table 7.13-EH- Enamel hypoplasia at Edix Hill, Barrington, Cambridgeshire.
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, UA = Adult of undetermined age, J = juvenile, TA = Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.14-EH shows the percentage of enamel hypoplasia at the site of North Elmham Park. Forty two individuals of 206 were affected by enamel hypoplasia (20.4 %). Twenty two males of 82 (26.8 %) and seventeen females of 76 (22.4 %) were affected. Three juveniles of 39 showed evidence of enamel hypoplasia (7.7 %).At this site 240 teeth of 1577 (15.2 %) showed signs of enamel hypoplasia. One hundred and thirty nine male teeth of 778 (17.9 %), and one hundred and one female teeth of 799 (12.6 %) were affected.

	North Elmham Park, Norfolk (Wells and Cayton, 1980)					
	n	N	%	t	TT	%
M	22	82	26.8	139	778	17.9
F	17	76	22.4	101	799	12.6
U		9				
J	3	39	7.7			
TA		167				
Total	42	206	20.4	240	1577	15.2

Table 7.14-EH- Enamel hypoplasia at North Elmham Park, Norfolk
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.15-EH shows the prevalence of enamel hypoplasia at the site of Burgh Castle, Norfolk. Fifty five individuals of 197 (32.9 %) had evidence of enamel hypoplasia. Thirty five males of 79 (44.3 %) and twenty females of 64 (31.3 %) were affected. In total, fifty five adults of 167 (32.9 %) had enamel hypoplasia.

	Burgh Castle, Norfolk (Anderson and Birkett, 1991, 1993)					
	n	N	%	t	TT	%
M	35	79	44.3		793	
F	20	64	31.3		554	
U		24				
J		30				
TA	55	167	32.9			
Total	55	197	32.9		1347	

Table 7.15-EH- Enamel hypoplasia at Burgh Castle, Norfolk
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Summary of Early Medieval enamel hypoplasia data

Table 7.16-EH and Figure 7.2-EH shows the percentage of individuals and teeth affected by enamel hypoplasia for all the Early Medieval sites. During this period, the site of

Staunch Meadow has the highest rate of enamel hypoplasia by individuals affected (36.1 %), followed by Burgh Castle (32.9 %) and Eccles (25.4 %). North Elmham Park had a prevalence of 20.4 %. The lower rates were at Nazeingbury (13.6 %) and Edix Hill, Barrington (10.8 %).

As for the percentage of teeth affected by enamel hypoplasia, at the site of North Elmham Park the rate was 15.2 % and at Edix Hill, Barrington the rate was 4.0 %.During the Early Medieval period, the mean prevalence of enamel hypoplasia by individuals and teeth affected is 23.2 % and 9.6 %, respectively.

Site Name	Early Medieval Sites					
	n	N	%	t	TT	%
Great Chesterford, Essex		167			1751	
Wicken Bonhunt, Essex		222			2190	
Nazeingbury, Essex	21	154	13.6			
Buckland, Dover, Kent		162			1581	
Eccles, Kent	43	169	25.4		1424	
Staunch Meadow, Brandon, Suffolk	57	158	36.1		2040	
Edix Hill, Barrington, Cambridgeshire	16	148	10.8	81	1600	4.0
North Elmham Park, Norfolk	42	206	20.4	240	1577	15.2
Burgh Castle, Norfolk	55	197	32.9		1347	
Mean Prevalence			23.2			9.6

Table 7.16-EH- Prevalence of enamel hypoplasia, Early Medieval sites.
(n = number of individuals affected, N = total number of individuals, % percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth from site.
Note: Blank cells indicate that information was not provided by the skeletal report.

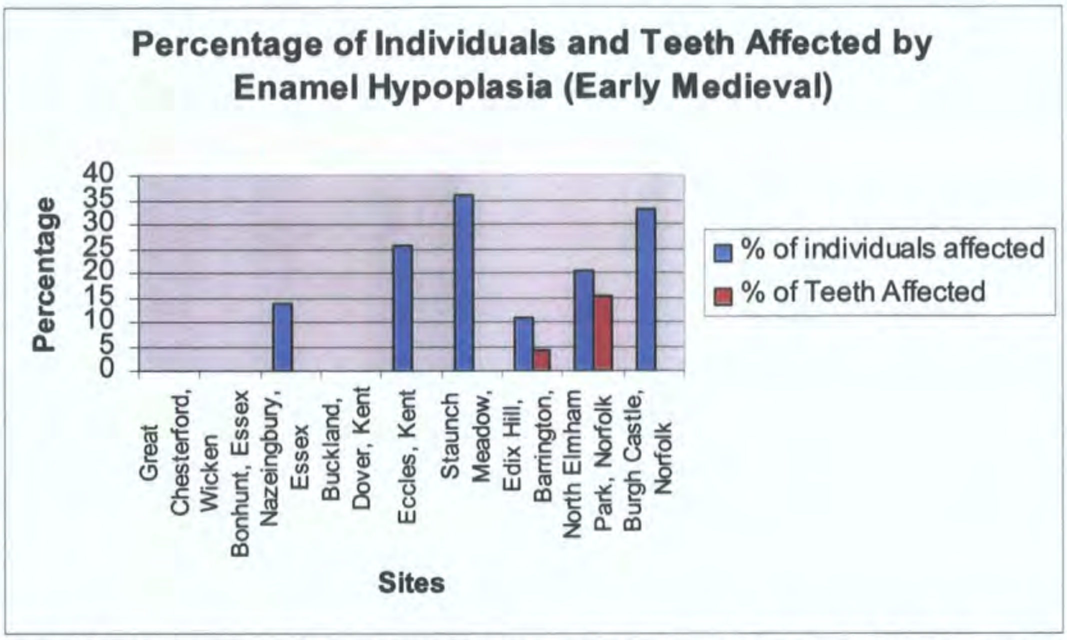


Figure 7.2-EH- Percentages of individuals and teeth affected by enamel hypoplasia, Early Medieval sites.

7.3.3 Late Medieval Enamel hypoplasia

Table 7.17-EH gives the prevalence of enamel hypoplasia at the site of Blackfriars Friary. Fifty three of 250 individuals (21.2 %) were affected by enamel hypoplasia. Thirty six males of 148 (24.3 %) and eleven females of 64 (17.2 %) were affected. Also, six of 24 juveniles (25.0%) showed evidence of enamel hypoplasia.

	Blackfriars Friary, Ipswich, Suffolk (Mays, 1991)					
	n	N	%	t	TT	%
M	36	148	24.3		2039	
F	11	64	17.2		854	
U		14				
J	6	24	25.0			
TA		226				
Total	53	250	21.2		2893	

Table 7.17-EH- Enamel hypoplasia at Blackfriars Friary, Ipswich in Suffolk
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

The site of St James and St Mary Magdalene Hospital (Table 7.18-EH) had a rate of enamel hypoplasia of 54.2 % (208 individuals of 384). Fifty three females of 75 (70.7%) and one hundred and twenty males of 191 (62.8 %) were affected by enamel hypoplasia. The total number of adults of undetermined sex is 18. It is interesting to note that 35 individuals were also affected by this dental condition however no explanation is given about who these individuals are. Therefore these 35 individuals are not placed in the following Table, but they are accounted for in the total of individuals affected. One thousand three hundred and thirty three teeth of 4344 (30.7 %) were affected by enamel hypoplasia. Eight hundred and sixty male teeth of 2826 (30.4%) and two hundred and eighty one female teeth of 1076 (26.1 %) were affected.

	St James and St Mary Magdalene Hospital, Chichester, Sussex (Lee and Magilton, 1989; Magilton and Lee, 1989)					
	n	N	%	t	TT	%
M	120	191	62.8	860	2826	30.4
F	53	75	70.7	281	1076	26.1
U		18			442	
J		100				
TA		284				
Total	208	384	54.2	1333	4344	30.7

Table 7.18-EH- Enamel hypoplasia at St James and St Mary Magdalene Hospital, Chichester, Sussex (n = number of individuals affected, N = total number of individuals, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.19-EH is concerned with the prevalence of enamel hypoplasia at the Late Medieval site of Royal Mint. However, dental pathology was not included in the skeletal report.

	Royal Mint, St Mary Graces Priory, London (Waldron, 1993)					
	n	N	%	t	TT	%
M		376				
F		249				
U		65				
J		244				
TA		690				
Total		934				

Table 7.19-EH- Enamel hypoplasia at Royal Mint, St Mary Graces Priory, London
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.20-EH shows the prevalence of enamel hypoplasia at the site of Spitalfields Market, London. Eighty one individuals of 200 (40.5 %) had enamel hypoplasia. Five hundred and forty nine teeth of 3159 (17.4%) were affected.

	Spitalfields Market, London (Connell, 2002; Conheeney, 1997)					
	n	N	%	t	TT	%
M		83				
F		76				
U		9				
J		32				
TA		168				
Total	81	200	40.5	549	3159	17.4

Table 7.20-EH- Enamel hypoplasia at Spitalfields Market, London
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.21-EH was meant to show the prevalence of enamel hypoplasia at the site of St. Nicholas Shambles. White (1988:49) mention that there is a high prevalence of enamel hypoplasia at St. Nicholas Shambles but no data was provided in the skeletal report.

	St. Nicholas Shambles, London (White, 1988)					
	n	N	%	t	TT	%
M		90				
F		77				
U		21				
J		46				
TA		188				
Total		234			790	

Table 7.21-EH- Enamel hypoplasia at St. Nicholas Shambles, London
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.
Note: Report mention high incidence of enamel hypoplasia but no numbers given.

Table 7.22-EH shows the rate of enamel hypoplasia at the site of Stratford Langthorne Abbey. Two hundred and fifteen individuals of 647 (33.3 %) were affected by enamel hypoplasia and it was mostly found in the crowns of the adult teeth (White, 1999).

	Stratford Langthorne Abbey, Essex (White, 1999; Stuart-Macadam (1985b, 1986)					
	n	N	%	t	TT	%
M		536			7106	
F		28				
U		55				
J		28				
UA						
TA		619				
Total	215	647	33.3		7106	

Table 7.22-EH- Enamel hypoplasia at Stratford Langthorne Abbey, Essex
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

The site of Thetford in Norfolk (Table 7.23-EH) had a prevalence of enamel hypoplasia of 12.8 %. Only, 19 of 149 individuals were affected by enamel hypoplasia. Stroud (1993:168) mentions that the majority of the teeth found (1286 teeth in total) were in poor condition with damage on the enamel which made the recording of enamel hypoplasia impossible. No explanation is given in the report of who (male, female, etc) is affected by enamel hypoplasia.

	Thetford, Norfolk (Stroud, 1993)					
	n	N	%	t	TT	%
M		19				
F		21				
U		47				
J		62				
TA		87				
Total	19	149	12.8		1286	

Table 7.23-EH- Enamel hypoplasia at Thetford, Norfolk
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Summary of Late Medieval enamel hypoplasia data

Table 7.24-EH and Figure 7.3-EH shows the prevalence of individuals and teeth affected by enamel hypoplasia for all the Late Medieval sites studied. The highest rate of enamel hypoplasia in this period is at St. James and St Mary Magdalene Hospital, Chichester (54.2 %), followed by Spitalfields Market (40.5 %). Next is a rate of 33.3 % (Stratford Langthorne Abbey). One of the lower rates in this period is at the site of Blackfriars Friary, Ipswich (21.2 %) but the lowest rate overall is at Thetford (12.8 %).

Site Name	Late Medieval Sites					
	n	N	%	t	TT	%
Blackfriars Friary, Ipswich, Suffolk	53	250	21.2		2893	
St. James and St Mary Magdalene Hospital, Chichester, Sussex	208	384	54.2	1333	4344	30.7
Royal Mint, St Mary Graces Priory, London		934				
Spitalfields Market, London	81	200	40.5	549	3159	17.4
St. Nicholas Shambles, London		234			790	
Stratford Langthorne Abbey, Essex	215	647	33.3		7106	
Thetford, Norfolk	19	149	12.8		1286	
Mean Prevalence			32.4			24.0

Table 7.24-EH- Individuals and Teeth affected by Enamel Hypoplasia in the Late Medieval Sites
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals and teeth affected, t = number of teeth affected, TT = Number of teeth, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

It is interesting to note that St. James and St Mary Magdalene Hospital, Chichester, also had the highest percentage of teeth affected (30.7 %).The other site where the percentage of teeth affected by enamel hypoplasia was recorded is the site of Spitalfields Market, London with 17.4 %. During the Late Medieval period, the mean prevalence of enamel hypoplasia by individuals and teeth affected is 32.4 % and 24.0 %, respectively.

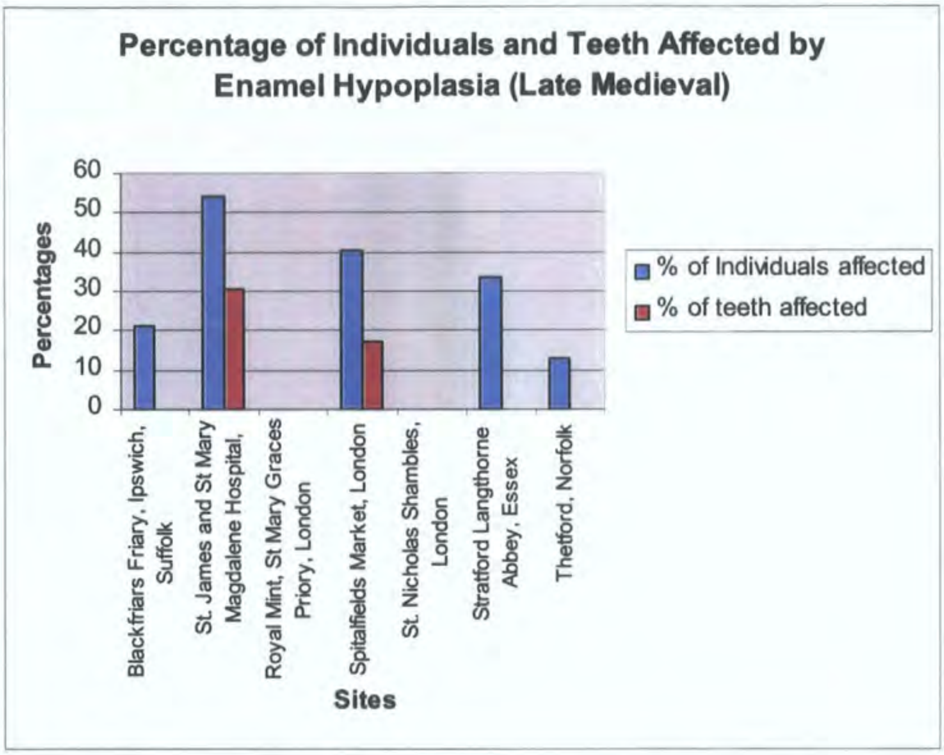


Figure 7.3-EH- Percentage of Individuals and Teeth affected by Enamel Hypoplasia, Late Medieval Sites

7.3.4 Enamel hypoplasia: All Periods

Figure 7.4-EH shows the prevalence of individuals and teeth affected by enamel hypoplasia for all the sites from each period. Of the total of 21 sites studied only 16 presented information about the prevalence of enamel hypoplasia by individual affected (five Romano-British sites, nine Early Medieval sites and seven Late Medieval). The highest prevalence of enamel hypoplasia is found at the Romano-British site of Eastern Cemetery of Roman London (57.6 %); the Late Medieval site of St. James and St. Mary Magdalene Hospital, Chichester is next (54.2 %), followed by the Late Medieval site of Spitalfields Market (40.5 %). The site of Staunch Meadow comes next with 36.1 %. Next was the Late Medieval site of Stratford Langthorne Abbey (33.3 %), followed by 32.9 % at Burgh Castle.

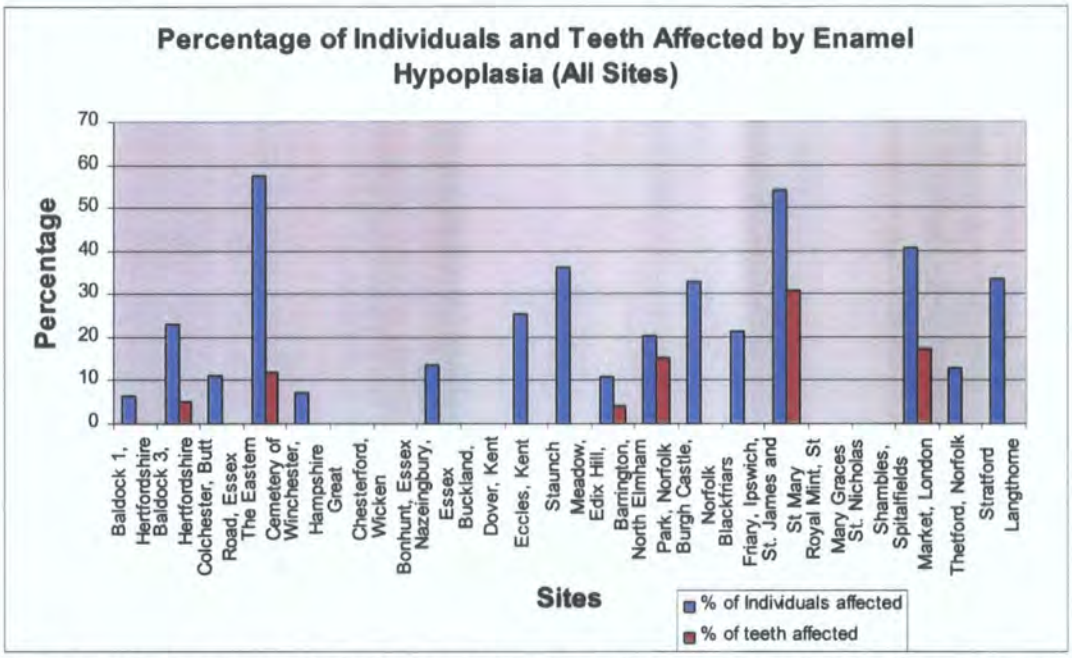
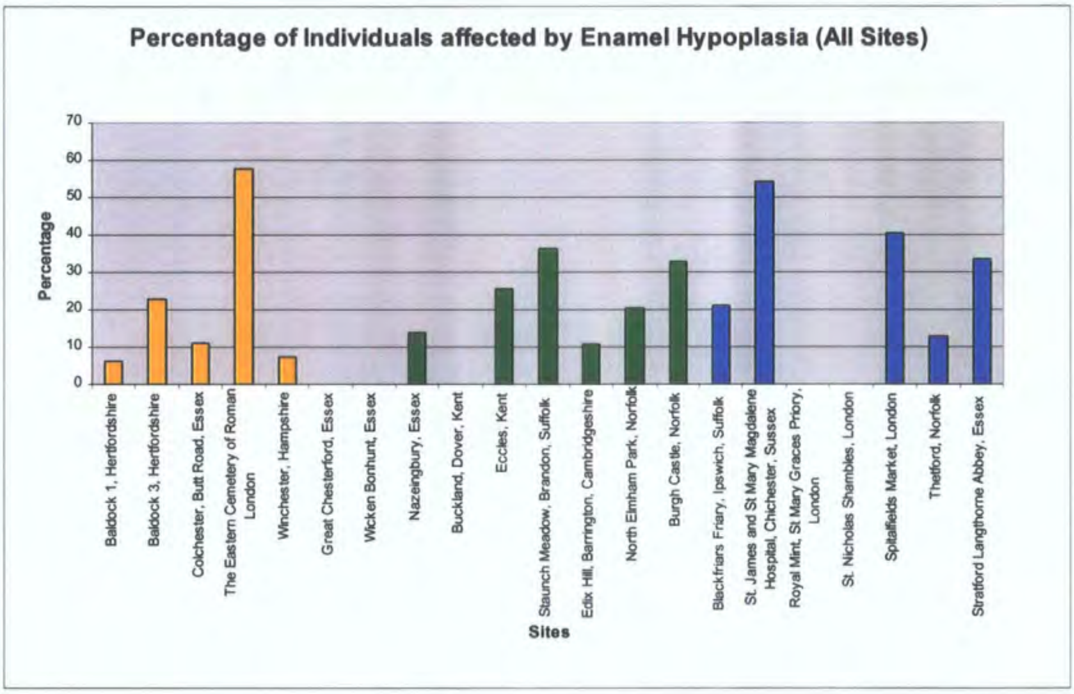


Figure 7.4-EH- Prevalence of individuals and teeth affected by enamel hypoplasia in all pooled British sites.

With a prevalence of 25.4 %, the Early Medieval site of Eccles is the first site with a rate less than 30 %. Both the Romano-British site of Baldock 3 and the Late Medieval site of Blackfriars Friary, Ipswich follows with a rate of 22.9 % and 21.2 %, respectively. The Early Medieval site of North Elmham Park is next (20.4 %), then 13.6 % at the Early Medieval site of Nazeingbury; this latter site is the first with a rate less than 20 %.This is followed by the Late Medieval site of Thetford (12.8%). Both the Romano-British site of Colchester, Butt Road and the Early Medieval site of Edix Hill have rates of 11.1 % and 10.8 %, respectively. The lower prevalence rates are observed in two Romano-British sites: the Eastern Cemetery of Roman London (7.2 %) and Baldock 1 (6.3 %).

Only six of the 21 skeletal reports studied provided information about the percentage of teeth affected with enamel hypoplasia. The highest percentage of teeth affected is found at the Late Medieval site of St. James and St Mary Magdalene Hospital (30.7 %). The Late Medieval site of Spitalfields Market follows (17.4 %). The Early Medieval site of North

Elmham Park is next (15.2 %), followed by the Romano-British site of The Eastern Cemetery of Roman London (11.9 %). The lowest rates are found in both the Romano-British site of Baldock 3 and the Early Medieval site of Edix Hill, Barrington 5.2 % and 4.0 %, respectively. For a separate and detailed graphic indication of these data see Figure 7.5-EH and Figure 7.6-EH.



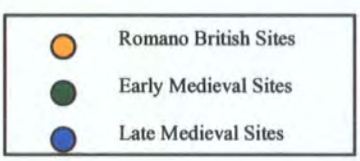


Figure 7.5-EH- Prevalence of individuals affected by enamel hypoplasia in all the British sites.

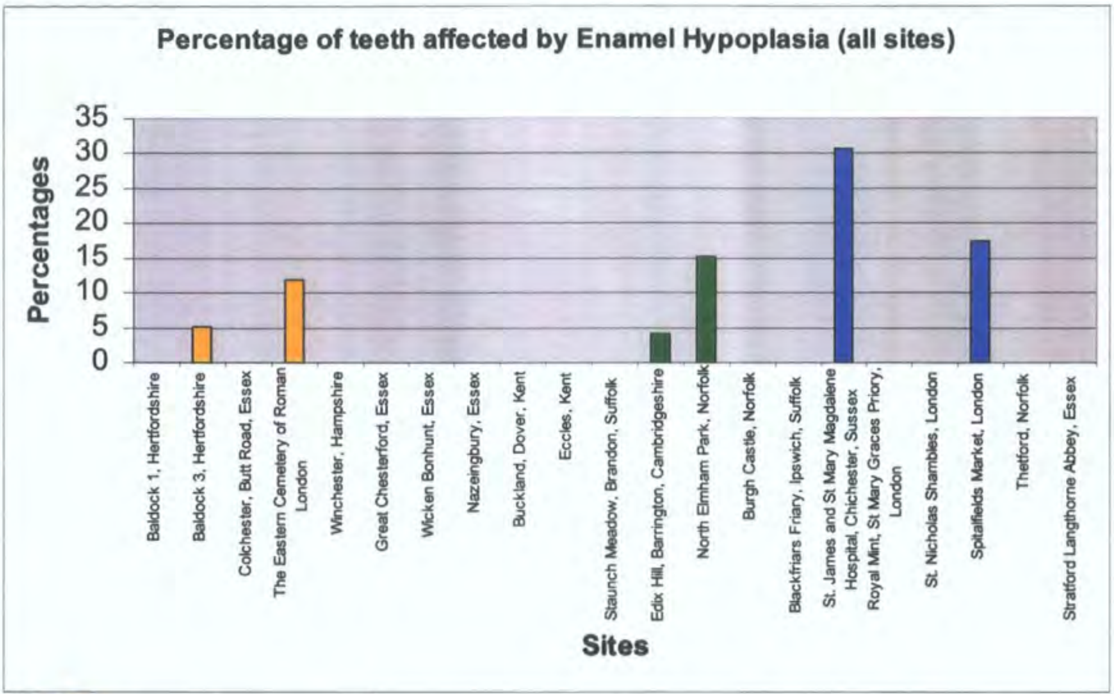


Figure 7.6-EH- Prevalence of teeth affected by enamel hypoplasia in all the British sites

Table 7.25-EH and Figure 7.7-EH show the overall mean prevalence of individuals affected with enamel hypoplasia by period. Within the pooled samples for the three periods studied the highest rate of enamel hypoplasia is found in the Late Medieval period (32.4 % of individuals affected), while the prevalence for the Early Medieval period is lower (23.2 %). The lowest rate is found in the Romano-British period (21.0 %). The enamel hypoplasia distribution by individuals affected was significantly different between the Romano-British period and the Early Medieval period ($X^2 = 7.085$, $p<0.01$, d.f. = 1) but not statistically significant between the Early Medieval period and the Late Medieval period ($X^2 = 1.580$, $p<0.1$, d.f. = 1). Differences in enamel hypoplasia prevalence between the three periods were found to be statistically significant ($X^2 = 21.0782$, $p<0.001$, d.f. = 2). Clearly there is an increase in the prevalence of enamel hypoplasia through time.

Sites	% of Individuals Affected
Romano British	21.0
Early Medieval	23.2
Late Medieval	32.4

Table 7.25-EH- Prevalence of individuals affected with enamel hypoplasia by period

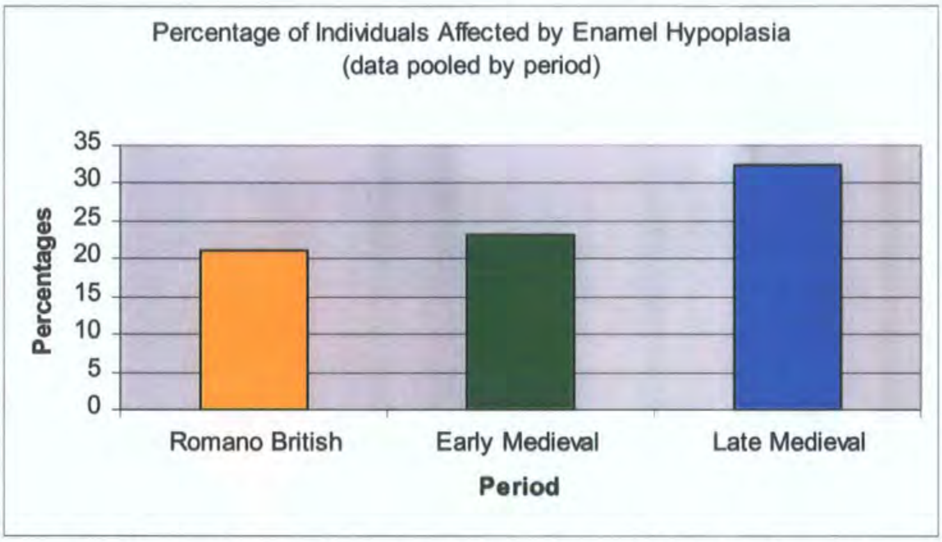


Figure 7.7-EH- prevalence of individuals affected with enamel hypoplasia by period

Table 7.26-EH and Figure 7.8-EH show the mean prevalence of teeth affected by enamel hypoplasia for each period. The highest prevalence is during the Late Medieval period (24.0 % of teeth affected), followed by a much lower rate for the Early Medieval period (9.6 %). The Romano-British period has the lowest prevalence of teeth affected (8.5 %). The enamel hypoplasia distribution by teeth affected was significantly different between the Romano-British and the Early Medieval periods ($X^2 = 130.114$, $p<0.001$, d.f. = 1) and statistically significant between the Early Medieval and the Late Medieval periods ($X^2 = 673.638$, $p<0.001$, d.f. = 1). Differences in enamel hypoplasia prevalence by teeth affected between the three periods were found to be statistically significant ($X^2 = 1413.0390$, $p<0.001$, d.f. = 2). The percentage of teeth affected by enamel hypoplasia clearly increases through time.

Periods	% of Teeth Affected
Romano British	8.5
Early Medieval	9.6
Late Medieval	24.0

Table 7.26-EH- Prevalence of teeth affected with enamel hypoplasia by period

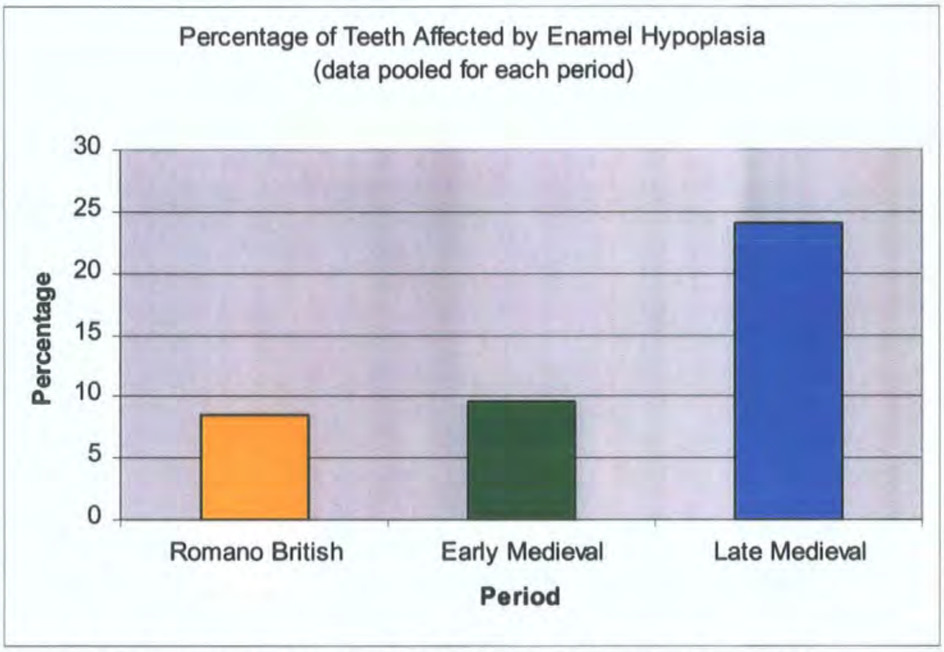


Figure 7.8-EH- prevalence of teeth affected with enamel hypoplasia by period.

7.4 Stature (S)

7.4.1 Romano-British: Male Stature

Table 7.1-S and Figure 7.1-S show the mean for male stature in all the Romano-British sites studied and their respective minimum and maximum stature range are also presented. Among the Romano-British sites, males were shortest at Baldock 3 (1.67m); the stature range was 1.60m to 1.75m (23 individuals). On the other hand, males from Colchester, Butt Road and Winchester were of equal height (1.68m). At Colchester male height ranged from 1.54m to 1.90m (85 individuals). At Winchester the height range was 1.53m and 1.79m (79 individuals).

Adult stature	Male mean stature	Male Minimum stature (m+cm)	Male Maximum stature (m+cm)	n=
Baldock 1, Hertfordshire	1.69	1.51	1.81	68
Baldock 3, Hertfordshire	1.67	1.60	1.75	23
Colchester, Butt Road, Essex	1.68	1.54	1.90	85
The Eastern Cemetery of Roman London	1.69	1.58	1.80	104
Winchester, Hampshire	1.68	1.53	1.79	79

Table 7.1-S- Mean male stature for all the Romano-British sites with minimum and maximum range (m = metres, cm = centimetres, n = number of male individual used to determine male mean stature).

The sites of Baldock 1 and The Eastern Cemetery of Roman London yielded similar mean heights (1.69m), or the maximum mean height seen for this period. The range found for these last two sites were comparable, with one site having a range of 1.51m to1.81m (68 individuals) and the other a range of 1.58m to 1.80m (104 individuals), respectively.

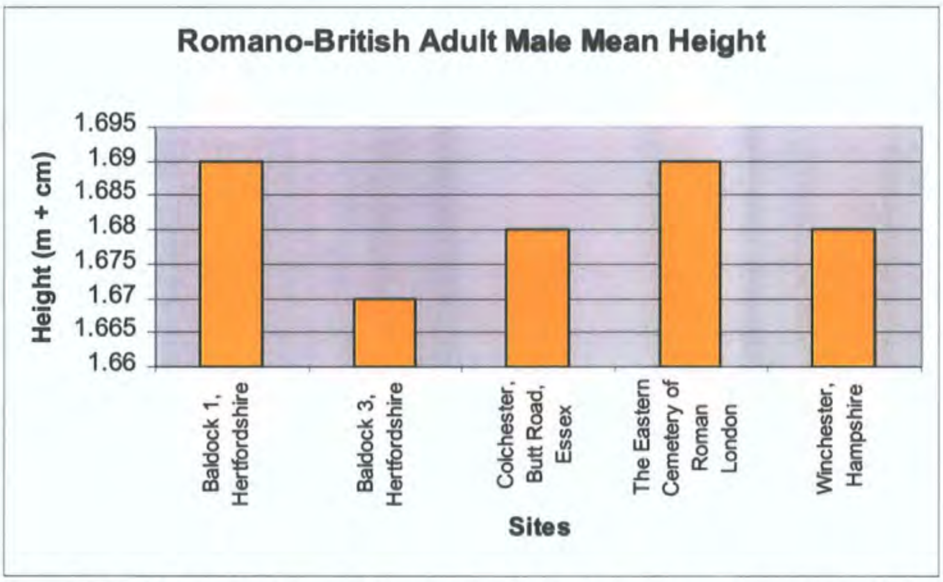


Figure 7.1-S- Mean male stature at Romano-British sites (m = metres, cm = centimetres).

7.4.2 Early Medieval: Male Stature

Mean male stature during the Early Medieval period, as well as their respective minimum and maximum range are presented in Table 7.2-S. Among these sites, males were shortest at Great Chesterford in Essex (1.66m); the stature range was 1.51m to 1.83m (28 individuals). Males at Staunch Meadow, Brandon had a mean height of 1.71m, with a range of 1.60m to 1.86m (24 individuals). Wicken Bonhunt, Eccles and North Elmham Park yielded similar mean heights (1.72m). Range of stature was 1.56m to 1.83m at Wicken Bonhunt (70 individuals), 1.62m to 1.92m at Eccles (55 individuals) and 1.62m to 1.80m at North Elmham Park (45 individuals).

Adult stature	**Male mean stature**	**Male Minimum stature (m+cm)**	**Male Maximum stature (m+cm)**	**n=**
Great Chesterford, Essex	1.66	1.51	1.83	28
Wicken Bonhunt, Essex	1.72	1.56	1.83	70
Nazeingbury, Essex	1.75	1.70	1.81	11
Buckland, Dover, Kent	1.74	1.69	1.82	6
Eccles, Kent	1.72	1.62	1.92	55
Staunch Meadow, Brandon, Suffolk	1.71	1.60	1.86	24
Edix Hill, Barrington, Cambridgeshire	1.73	1.60	1.84	35
North Elmham Park, Norfolk	1.72	1.62	1.80	45
Burgh Castle, Norfolk	1.75	1.65	1.86	54

Table 7.2-S- Mean male stature for all Early Medieval sites with minimum and maximum range (m = metres, cm = centimetres, n = number of male individual used to determine male mean stature).

The males at Edix Hill, Barrington had a mean stature of 1. 73m, with a range of 1.60m to 1.84m (35 individuals).With a mean stature of 1.74m, the males at Buckland, Dover were taller (range 1.69m to 1. 82m; 6 individuals). The tallest males had a mean stature of 1.75m at both Nazeingbury and Burgh Castle. At Nazeingbury height ranged from 1.70m to 1.81m (11 individuals), and at Burgh Castle the range was 1.65m to 1.86m (54 individuals). Figure 7.2-S shows male stature for all the Early Medieval sites.

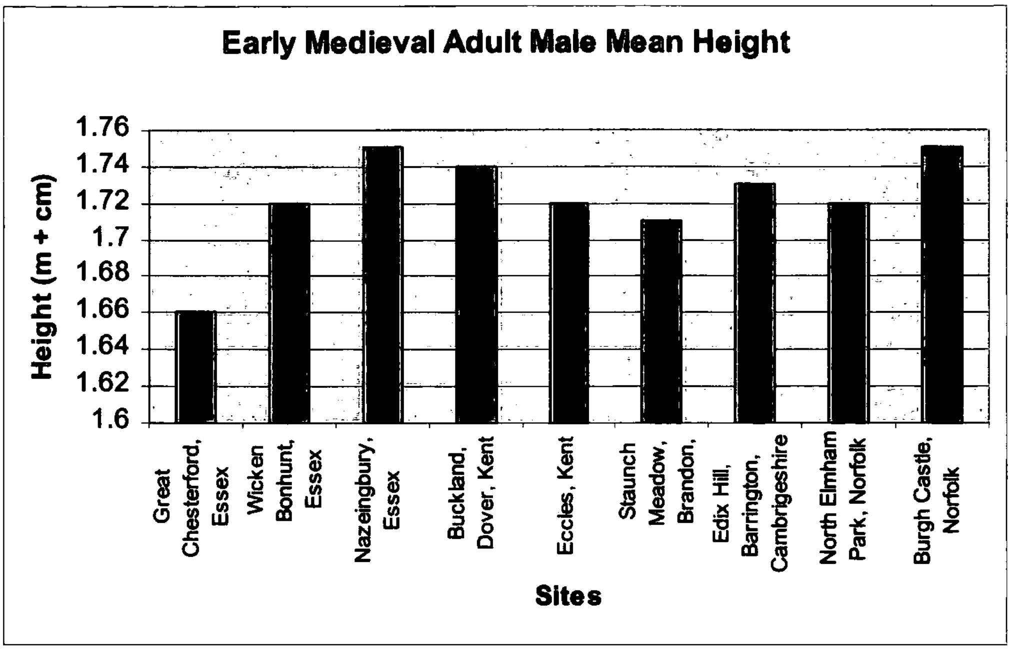


Figure 7.2-S- Mean male stature at Early Medieval sites (m = metres, cm = centimetres).

7.4.3 Late Medieval: Male Stature

Table 7.3-S shows the mean male stature at all the Late Medieval sites studied; their respective minimum and maximum stature range are also presented. The site of Royal Mint, St. Mary Graces Priory had the shortest males (1.68m); the stature range was 1.49m to 1.87m (196 individuals). St. James and St. Mary Magdalene Hospital, Spitalfields Market and Thetford yielded similar mean height (1.70m). Range of stature was 1.55m to 1.90m at St. James and St. Mary Magdalene Hospital (165 individuals), 1.58m to 1.83m at Spitalfields Market (62 individuals), and 1.63m to 1.82m at Thetford (18 individuals).

Adult stature	Male mean stature	Male Minimum stature (m+cm)	Male Maximum stature (m+cm)	n=
Blackfriars Friary, Ipswich, Suffolk	1.72	1.62	1.85	131
St James and St Mary Magdalene Hospital, Chichester, Sussex	1.70	1.55	1.90	165
Royal Mint, St Mary Graces Priory, London	1.68	1.49	1.87	196
St. Nicholas Shambles, London	1.72	1.59	1.87	
Spitalfields Market, London	1.70	1.58	1.83	62
Thetford, Norfolk	1.70	1.63	1.82	18
Stratford Langthorne Abbey, Essex	1.73	1.57	1.84	221

Table 7.3-S- Mean male stature in all the Late Medieval sites with minimum and maximum range (m = metres, cm = centimetres, n = number of male individual used to determine male mean stature).

The males at Blackfriars Friary, Ipswich and at St. Nicholas Shambles had a mean stature of 1.72 m. Range of stature was 1.62m to 1.85m at Blackfriars Friary (131 individuals) and 1.59m to 1.87m at St. Nicholas Shambles, unfortunately, the number of male individuals measured to calculate the mean stature at this site was not provided in the skeletal report. The tallest males had a mean stature of 1.73m at Stratford Langthorne Abbey. At Stratford Langthorne Abbey height ranged from 1.57m to 1.84m (221 individuals). Figure 7.3-S shows male stature for all the Late Medieval sites.

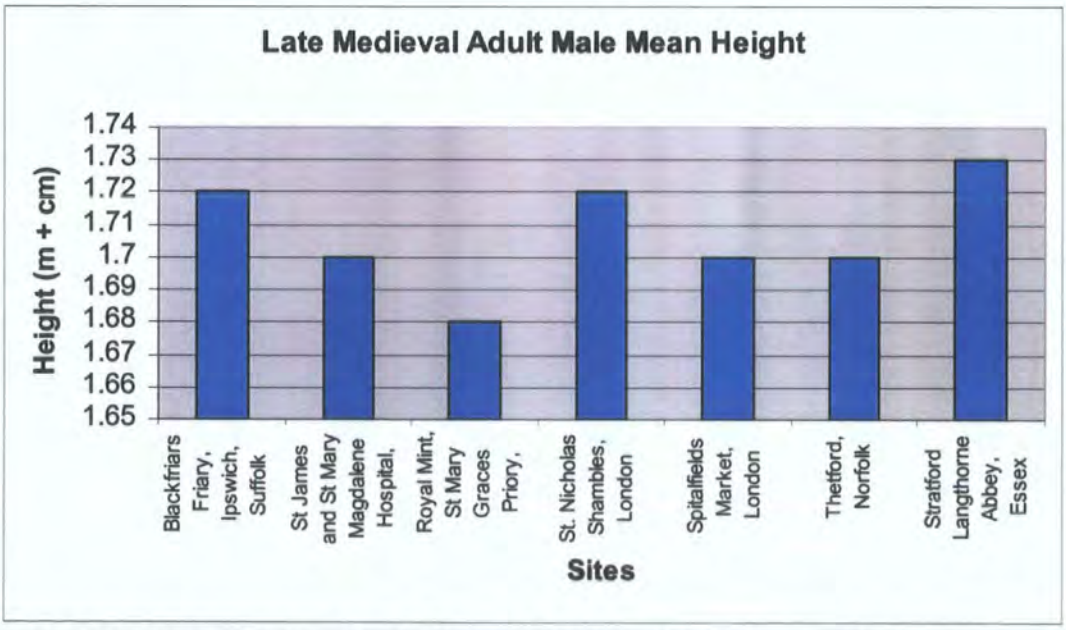
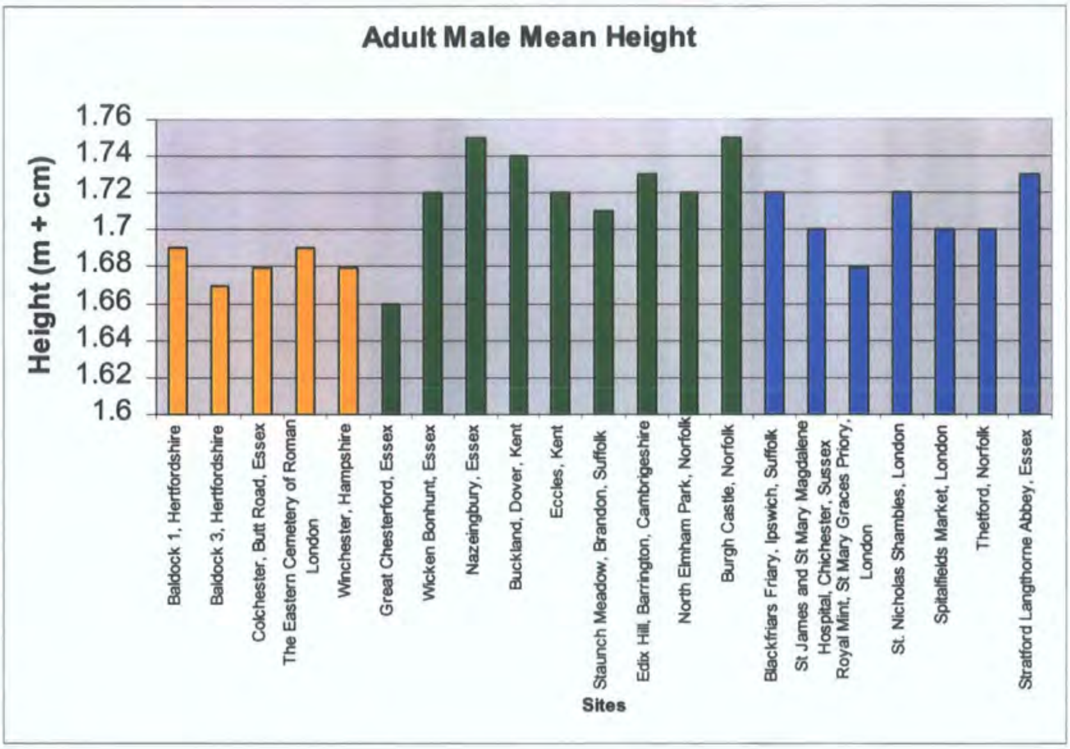


Figure 7.3-S- Mean male stature for all the Late Medieval sites (m = metres, cm = centimetres).

Figure 7.4-S compares mean male stature for all sites and periods. The tallest males come from the Early Medieval period and the shortest are those from the Romano-British period.



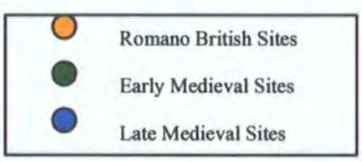


Figure 7.4-S- Comparison of male mean height for every site and period (m = metres, cm = centimetres).

Table 7.4-S and Figure 7.5-S show the overall male mean height by period. When the results are compared, males were tallest during the Early Medieval period than any other period (1.72m). During the Late Medieval period males were slightly shorter than the Early Medieval males (1.71m). The shortest males were those from the Romano-British period (1.68m).

Periods	Male Mean Height (m+cm)
Romano British Sites	1.68
Early Medieval Sites	1.72
Late Medieval Sites	1.71

Table 7.4-S- Comparison of male mean height by period (m = metres, cm = centimetres).

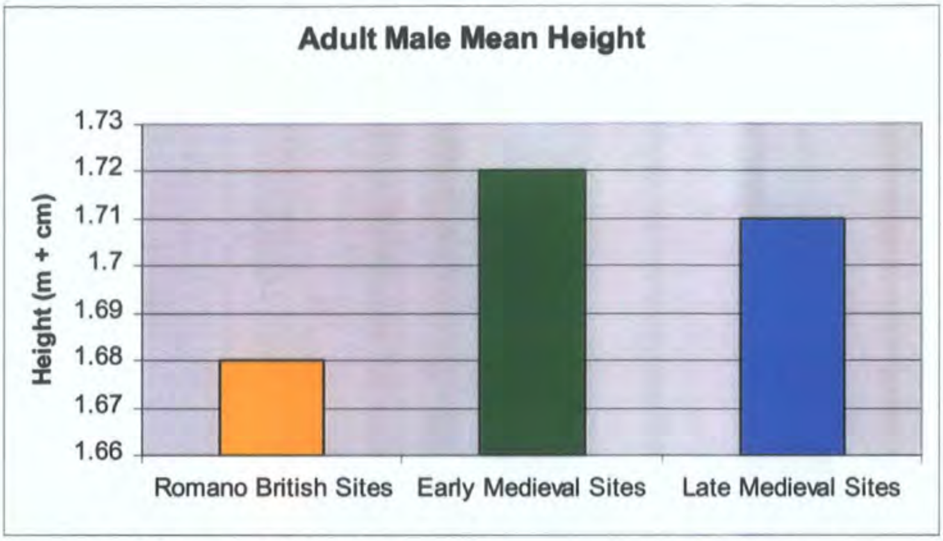


Figure 7.5-S- Male mean height in all periods (m = metres, cm = centimetres).

7.4.4 Romano-British: Female Stature

Table 7.5-S shows the means for female stature at all the Romano-British sites studied; their respective minimum and maximum stature range are also presented. Females were shortest at Colchester; Butt Road (1.56m), the stature range was 1.41m to 1.71m (59 individuals). At Baldock 1 mean height was (1.57m), stature ranged from 1.50m to 1.68m (43 females).

Adult stature	Female mean stature (m+cm)	Female Minimum stature (m+cm)	Female Maximum stature (m+cm)	n=
Baldock 1, Hertfordshire	1.57	1.50	1.68	43
Baldock 3, Hertfordshire	1.58	1.51	1.68	15
Colchester, Butt Road, Essex	1.56	1.41	1.71	59
The Eastern Cemetery of Roman London	1.58	1.45	1.72	75
Winchester, Hampshire	1.58	1.46	1.74	57

Table 7.5-S- Mean female stature for all the Romano-British sites with minimum and maximum range (m = metres, cm = centimetres, n = number of female individuals used to determine female mean stature).

Baldock 3, the Eastern Cemetery of Roman London and Winchester yielded similar female mean height (1.58m), introducing the maximum female mean height during this period. Range of stature was 1.51m to 1.68m at Baldock 3 (15 individuals), 1.45m to 1.72m at the

Eastern Cemetery (75 individuals) and 1.46m to 1.74m at Winchester (57 individuals).

Figure 7.6-S shows mean female stature in each of the Romano-British sites.

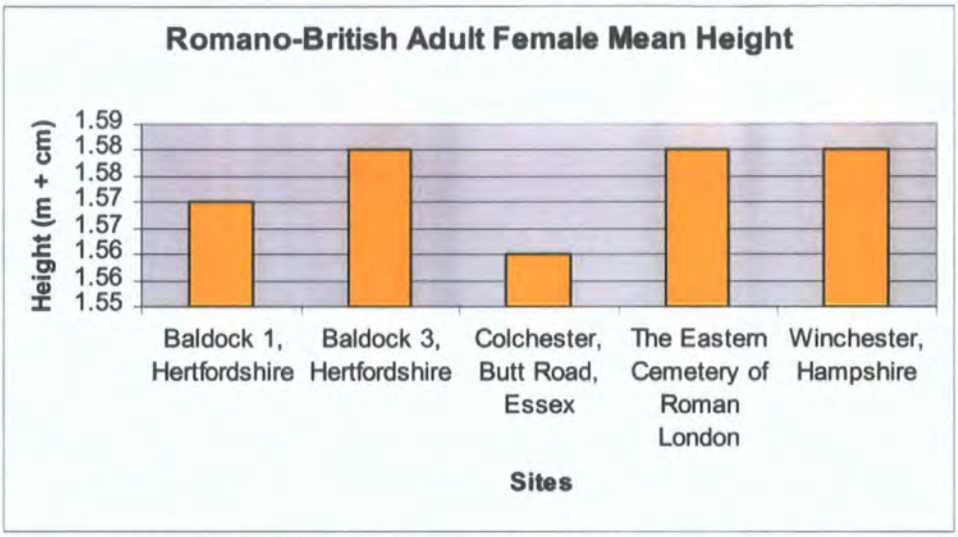


Figure 7.6-S- Mean female stature at Romano-British sites (m = metres, cm = centimetres).

7.4.5 Early Medieval: Female Stature

Mean female stature during the Early Medieval period, as well as their respective minimum and maximum range are presented in Table 7.6-S. Among these sites, females were shortest at North Elmham Park (1.57m); the stature range was 1.42m to 1.69m (39 individuals). Females at Great Chesterford and Staunch Meadow had the same female mean height (1. 61m). Range of stature was 1 46m to 1.71m at Great Chesterford (38 individuals) and 1.47m to 1.77m at Staunch Meadow (15 females).

Adult stature	Female mean stature (m+cm)	Female Minimum stature (m+cm)	Female Maximum stature (m+cm)	n=
Great Chesterford, Essex	1.61	1.46	1.71	38
Wicken Bonhunt, Essex	1.62	1.49	1.77	34
Nazeingbury, Essex	1.68	1.58	1.74	13
Buckland, Dover, Kent	1.66	1.61	1.71	8
Eccles, Kent	1.62	1.48	1.78	46
Staunch Meadow, Brandon, Suffolk	1.61	1.47	1.77	15
Edix Hill, Barrington, Cambridgeshire	1.63	1.51	1.71	30
North Elmham Park, Norfolk	1.57	1.42	1.69	39
Burgh Castle, Norfolk	1.63	1.51	1.76	38

Table 7.6-S- Mean female stature at all the Early Medieval sites with minimum and maximum range (m = metres, cm = centimetres, n = number of female individuals used to determine female mean stature).

The sites of Wicken Bonhunt and Eccles yielded similar mean heights (1.62m). Range of stature was 1.49m to 1.77m at Wicken Bonhunt (34 individuals) and 1.48m to 1.78m at Eccles (46 individuals). Mean height was similar at Edix Hill, Barrington and at Burgh Castle (1.63m). Range of stature was 1.51m to 1.71m at Edix Hill (30 individuals) and 1.51m to 1.76m (38 individuals).

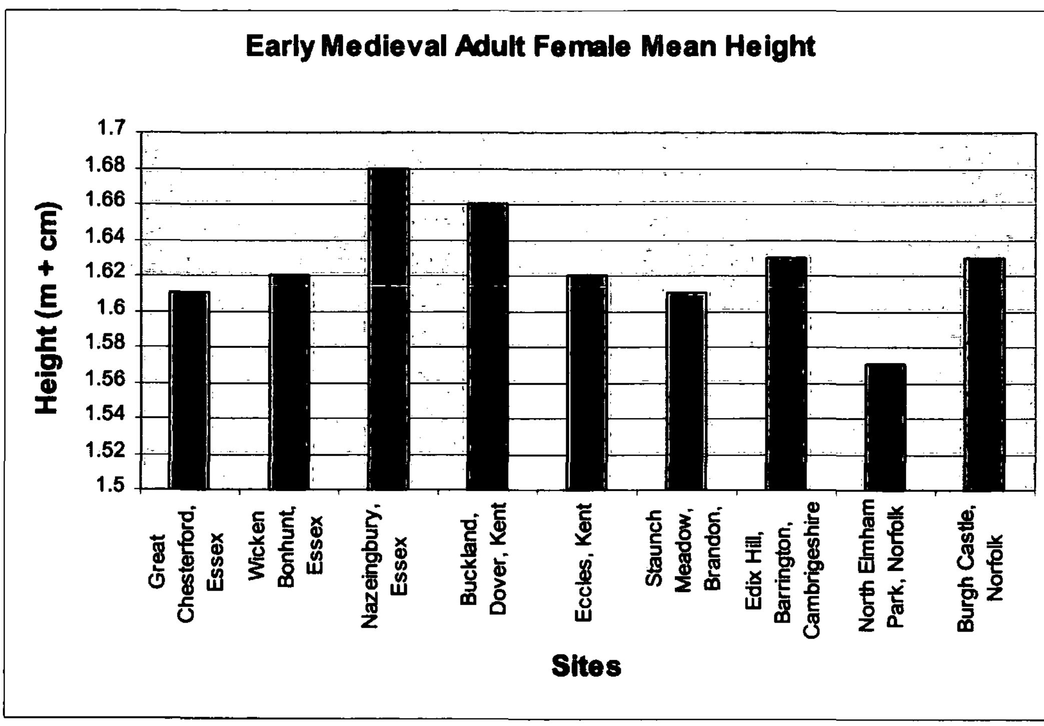


Figure 7.7-S- Mean female stature at all the Early Medieval sites (m = metres, cm = centimetres).

At Buckland, Dover female mean height was 1. 66m; stature range was 1.61m to 1.71m (8 individuals). Women were tallest at Nazeingbury (1.68m); height ranged from 1.58m to 1.74m (13 individuals). Figure 7.7-S shows mean female stature at each Early Medieval site.

7.4.6 Late Medieval: Female Stature

Table 7.7-S shows female mean heights at all the Late Medieval sites studied; their respective minimum and maximum stature range are also indicateed. The shortest females were at St. Nicholas Shambles (1.57m); stature ranged from 1.50m to 1.73m. Unfortunately, the number of females used to calculate the mean stature at this site is not given in the skeletal report. At Thetford females were slightly taller (1.58m). Range of stature was 1.45m to 1.67m (19 individuals).

Adult stature	**Female mean stature (m+cm)**	**Female Minimum stature (m+cm)**	**Female Maximum stature (m+cm)**	**n=**
Blackfriars Friary, Ipswich, Suffolk	1.61	1.46	1.76	58
St James and St Mary Magdalene Hospital, Chichester, Sussex	1.59	1.52	1.69	70
Royal Mint, St Mary Graces Priory, London	1.59	1.45	1.77	112
St. Nicholas Shambles, London	1.57	1.50	1.73	
Spitalfields Market, London	1.59	1.43	1.70	58
Thetford, Norfolk	1.58	1.45	1.67	19
Stratford Langthorne Abbey, Essex	1.59	1.57	1.62	5

Table 7.7-S- Mean female stature at all the Late Medieval sites with minimum and maximum range (m = metres, cm = centimetres, n = number of female individuals used to determine female mean stature).

Females at St. James and St. Mary Magdalene Hospital, Royal Mint, St. Mary Graces Priory, Spitalfields Market and Stratford Langthorne Abbey in Essex shared the same female mean stature (1.59). Range of stature was 1.52m to 1.69m at St. James and St. Mary Magdalene Hospital (70 individuals), 1.45m to 1.77m at Royal Mint (112 individuals), 1.43m to 1.70m at Spitalfields Market (58 individuals) and 1.57m to 1.62m at Stratford Langthorne Abbey (5 individuals). The tallest females were at Blackfriars Friary, Ipswich (1.61m); stature ranged from 1.46m to 1.76 (58 individuals). Figure 7.8-S shows mean female stature in each of the Late Medieval sites.

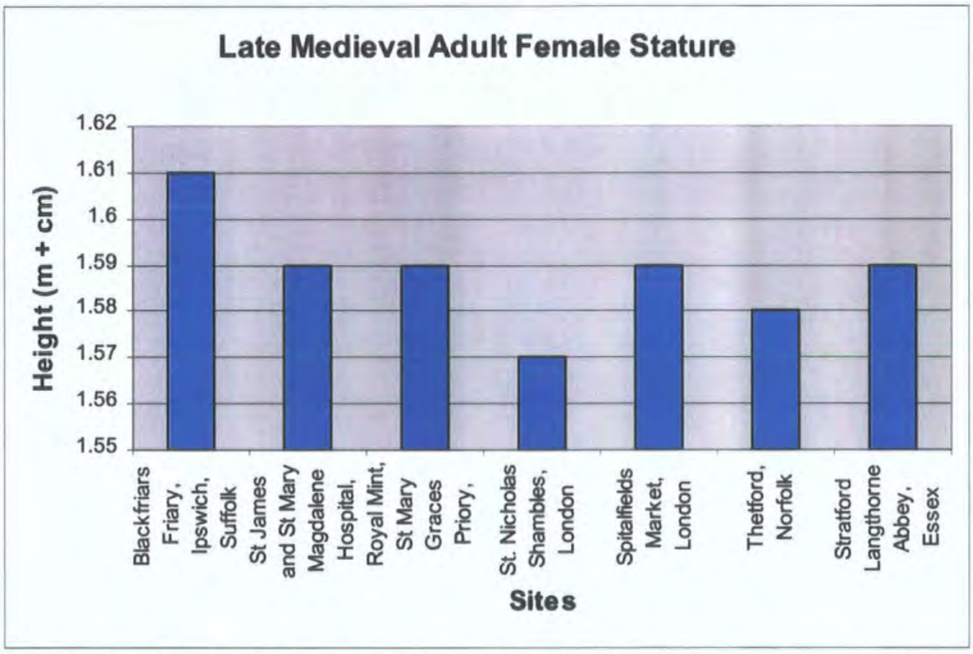
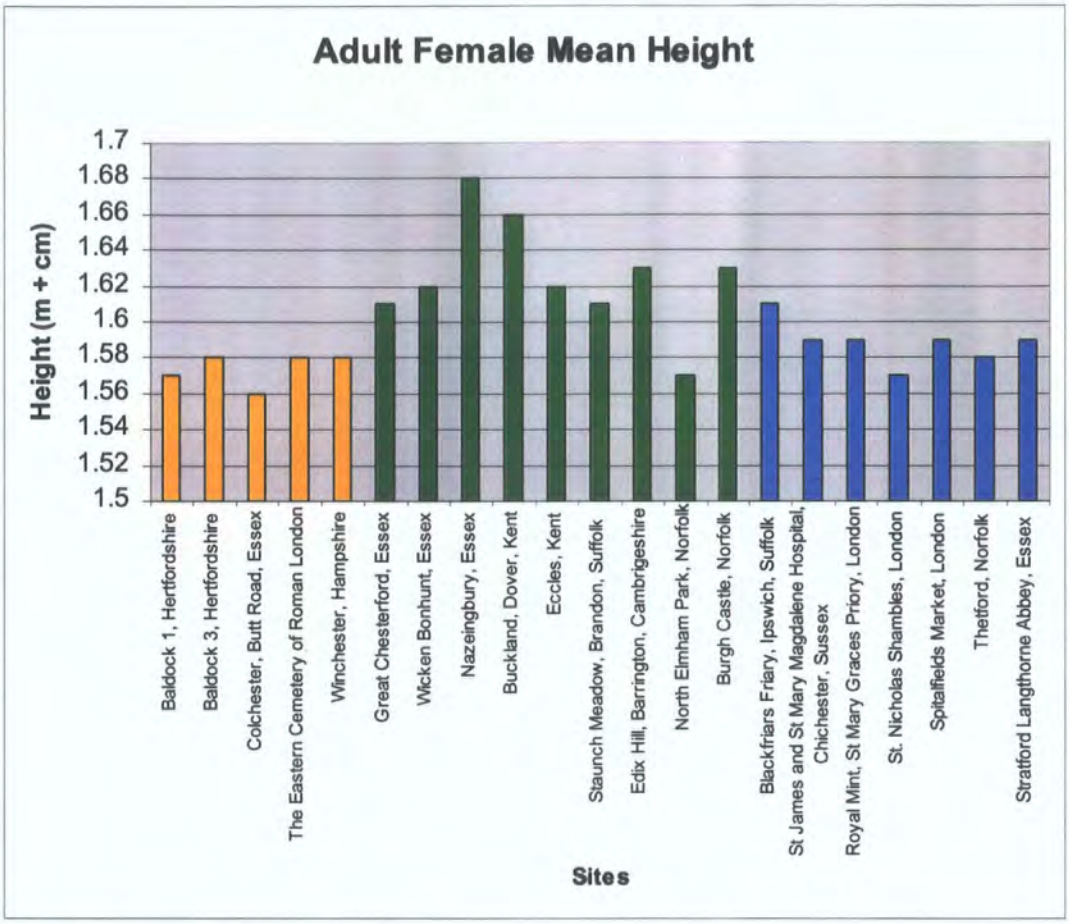


Figure 7.8-S- Mean female stature at all the Late Medieval sites (m = metres, cm = centimetres).

Figure 7.9-S compares mean female stature for all sites and periods. The tallest females come from the Early Medieval period and the shortest are those from the Romano-British period.



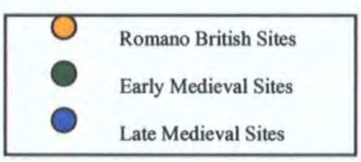


Figure 7.9-S- Comparison of female mean height from in every site and period (m = metres, cm = centimetres).

Table 7.8-S and Figure 7.10-S show the overall female mean height by period. When the results are compared females were tallest during the Early Medieval period than any other period (1.63m). During the Late Medieval period females were slightly shorter than the Early Medieval females (1.59m). The shortest females were those from the Romano-British period (1.57m).

Periods	Female Mean Height (m+cm)
Romano British Sites	1.57
Early Medieval Sites	1.63
Late Medieval Sites	1.59

Table 7.8-S- Comparison of female mean height by periods (m = metres, cm = centimetres).

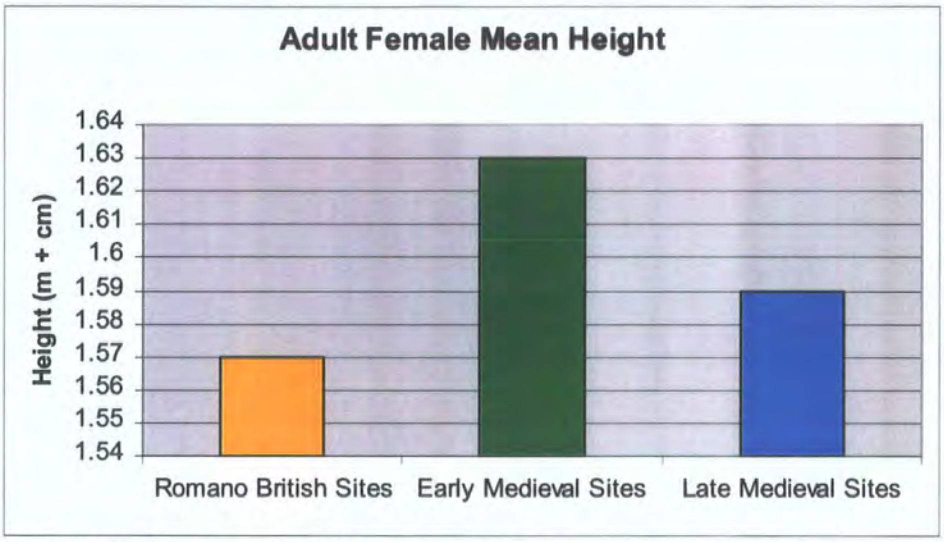


Figure 7.10-S- Female mean height in all periods (m = metres, cm = centimetres).

7.4.7 Comparison of Male and Female Stature

Figure 7.11-S compares male and female mean stature during the Romano- British period. At Baldock 1 the difference was 12 cm, at Baldock 3 nine cm, at Colchester, Butt Road 12 cm, at the Eastern Cemetery of Roman London 11 cm, and at Winchester was 10 cm.

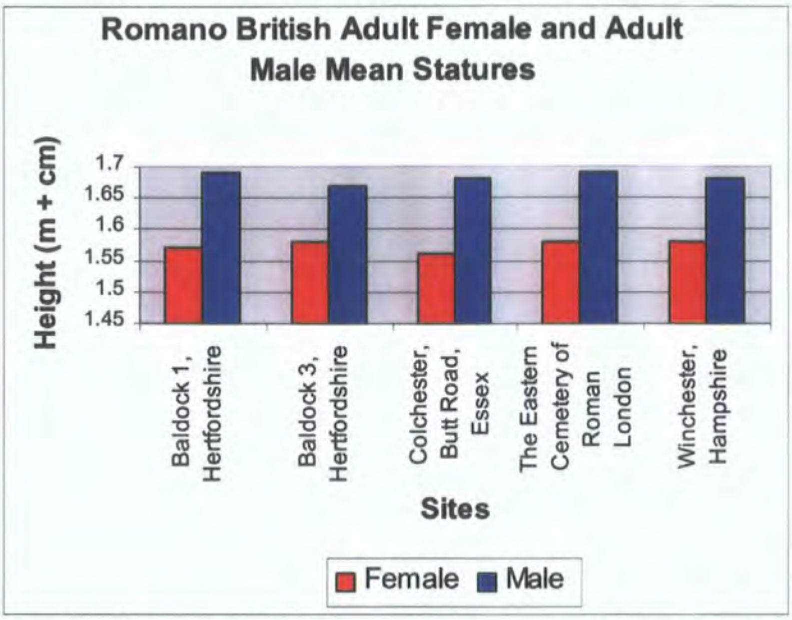


Figure 7.11-S- Comparison by site of male and female mean height during the Romano-British period (m = metres, cm = centimetres).

Figure 7.12-S compares male and female mean stature during the Early Medieval period. At Great Chesterford the difference was five cm, at Wicken Bonhunt was 10 cm, and at Nazeingbury was seven cm. At Buckland, Dover the difference between male and female height was eight cm, at Eccles 10 cm, at Staunch Meadow 10 cm, at Edix Hill, Barrington 10 cm, at North Elmham Park 15 cm and at Burgh Castle 12 cm.

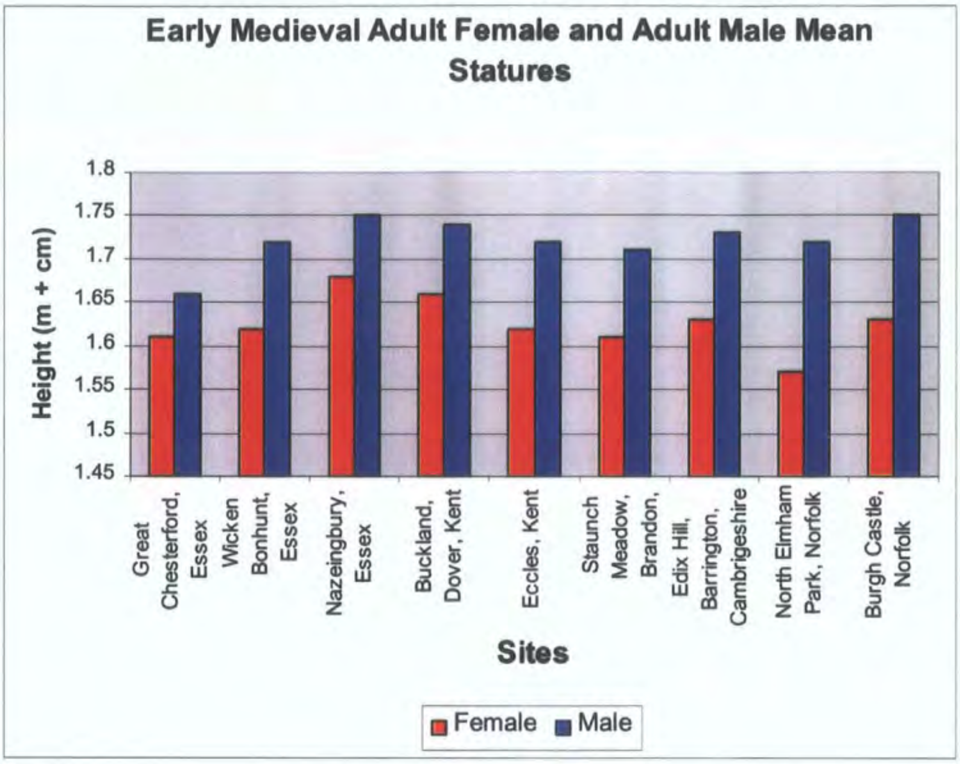


Figure 7.12-S- Comparison by site of male and female mean height during the Early Medieval period (m = metres, cm = centimetres).

Figure 7.13-S compares male and female mean stature during the Late Medieval period. At Blackfriars Friary, Ipswich the difference was 11 cm, at St. James and St. Mary Magdalene Hospital was 11 cm, and at the Royal Mint, St. Mary Graces Priory was nine cm. Interestingly, at St. Nicholas Shambles the difference was 15 cm, at Spitalfields Market 11 cm, at Thetford 12 cm and at Stratford Langthorne Abbey 14 cm.

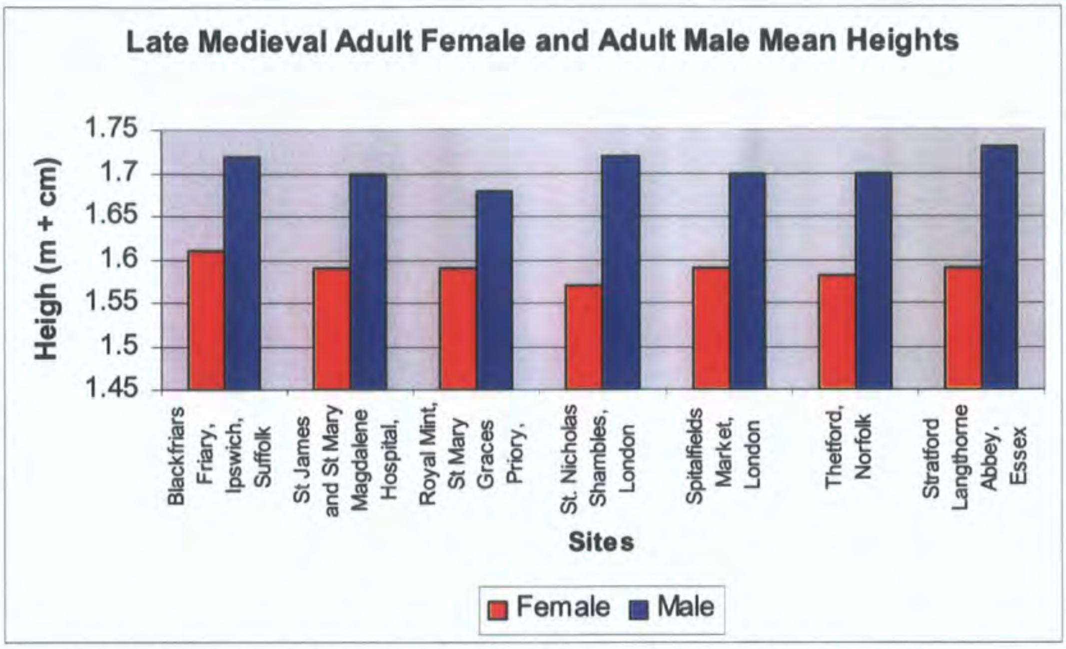


Figure 7.13-S- Comparison by site of male and female mean height during the Late Medieval period (m = metres, cm = centimetres).

Table 7.9-S and Figure 7.14-S compare pooled data for male and female mean height by period. Recent data from the Department of Health (2005) has also been included. Data from the three first periods shows that both males and females were tallest during the Early Medieval period with a nine cm difference between them. In the Late Medieval period, both males and females were shorter than the previous period, with a difference of 12 cm between them. The difference in stature between males of the Early Medieval and Late Medieval periods was one cm, between females was four cm.

	Female Mean Height (m+cm)	Male Mean Height (m+cm)
Romano British Sites	1.57	1.68
Early Medieval Sites	1.63	1.72
Late Medieval Sites	1.59	1.71
Department of Health 2005	1.61	1.75

Table 7.9-S- Comparison of male and female mean height by period (m = metres, cm = centimetres).

The shortest males and females were found during the Romano-British period. Males were 11 cm higher than the females. The difference in height between the males and females from the Early Medieval and Romano-British periods was 4 cm and 6 cm, respectively. To establish whether the stature means between the periods were statistically different the *t*-test was used. This shows that there was a significant change in stature between the Romano-British females and the Early Medieval females ($t\,(12) = -3.55, p = 0.004, SD = 0.26$) with Early Medieval females being taller. Romano-British female stature was relatively short ($M = 1.57, SD = 8.94$ 95 % confidence interval for mean) at between1.55 and 1.60 m and Early Medieval female stature was reasonably tall ($M = 1.63, SD = 3.13$ 95 % confidence interval for mean) at between 1.61 and 1.64m.

A *t*-test between the Early Medieval females and the Late Medieval females shows that there was a significant change in stature between these periods ($t\,(14) = -2.94, p = 0.011, SD = 0.25$) with Late Medieval females being the shorter. Late Medieval female stature was relatively short ($M = 1.59, SD = 1.22$, 95 % confidence interval for mean) at between 1.57 and 1.61 m and Early Medieval female stature was reasonably tall ($M = 1.63, SD = 3.13$, 95 % confidence interval for mean) at between 1.61 and 1.64 m.

Comparison of the Romano-British males and the Early Medieval males shows that there was a significant change in stature between these periods ($t\,(12) = -3.16, p = 0.008, SD = 0.23$) with Early Medieval males being taller. Romano-British male stature was relatively short ($M = 1.68, SD = 8.37$, 95 % confidence interval for mean) at between1.66 and 1.70 m and in Early Medieval male stature was reasonably tall ($M = 1.72, SD = 2.73$, 95 % confidence interval for mean) at between 1.71 to 1.74 m.

Comparing the Early Medieval males with the Late Medieval males shows that there was a significant change in stature between these periods (t (14) = - 1.28, p = 0.22, SD = 0.23) with Late Medieval males being shorter. Late Medieval male stature was slightly shorter (M = 1.71, SD = 1.70, 95 % confidence interval for mean) at between 1.69 and 1.73 m and Early Medieval male stature was somewhat taller (M = 1.72, SD = 2.73, 95 % confidence interval for mean) at between 1.71 and 1.74 m. In summary, for both sexes stature increased from the Roman-British to the Early Medieval period, but decreased during the Late Medieval period.

Figure 7.14-S displays stature data from the last health survey for England of modern height of males and females (Department of Health, 2005). It is clearly observed that today's height resembles that of the Early Medieval period. Modern males are three centimetres taller than Early Medieval males, but modern females are two centimetres shorter than Early Medieval females. Despite these differences, it is apparent that in England today males have achieved an important increase in height since Late Medieval times (a mean of four centimetres) and females have increased by two centimetres since the Late Medieval period.

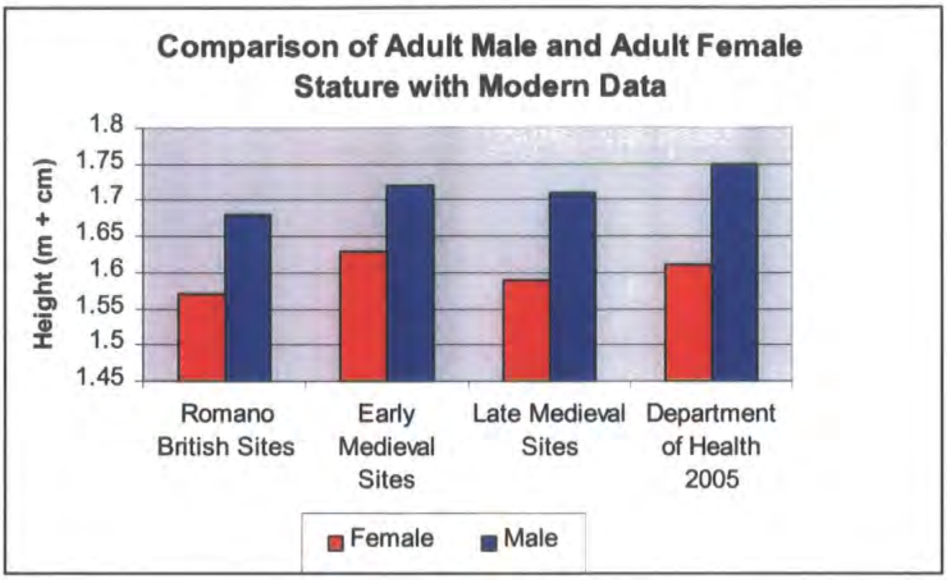


Figure 7.14-S- Comparison of Adult Male and Adult Female Stature with Modern Data

7.5 Cribra Orbitalia (CO)

7.5.1 Romano-British Cribra Orbitalia

Table 7.1-CO displays the prevalence of cribra orbitalia at the site of Baldock 1, Hertfordshire. In total, 31of the 191 individuals (16.2 %) found at this site were affected by cribra orbitalia. The highest prevalence of cribra orbitalia was seen in the adults of undetermined sex (80.0 %). Only four adults of undetermined sex of 5 were affected by cribra orbitalia. Fifteen of 74 males (20.3 %) had cribra orbitalia, 12 of 50 females (24.0%) and 31 of a total of 129 adults (24.0 %) were affected.

	Baldock 1, Hertfordshire (McKinley, 1993)		
	n	N	%
M	15	74	20.3
F	12	50	24.0
U	4	5	80.0
J		62	
TA	31	129	24.0
Total	31	191	16.2

Table 7.1-CO- Cribra orbitalia at Baldock 1, Hertfordshire
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of cribra orbitalia at the site of Baldock 3 can be observed in Table 7.2-CO. Eighteen individuals of 144 (12.5 %) have pitting on the orbits of the skull consistent with cribra orbitalia. Seven of 45 males (15.6 %) and 8 females of 63 (12.7 %) were affected by this metabolic disorder. Three adults of undetermined sex of 21 (14.3 %) were affected. In total, eighteen adults of 129 (14.0 %) were affected by cribra orbitalia.

	Baldock 3, Hertfordshire (Roberts, 1984)		
	n	N	%
M	7	45	15.6
F	8	63	12.7
U	3	21	14.3
J		15	
TA	18	129	14.0
Total	18	144	12.5

Table 7.2 CO- Cribra Orbitalia at Baldock 3, Hertfordshire
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.3-CO shows the prevalence of cribra orbitalia at the site of Colchester, Butt Road. Twenty nine individuals of 575 individuals (5.0 %) were diagnosed with cribra orbitalia. Nine juveniles of 108 (8.3 %) were affected. Nine females of 140 (6.4 %) and six males of 170 (3.5 %) displayed cribra orbitalia at their time of death. Also, five of 157 adults of

undetermined sex (3.2 %) had cribra orbitalia. Finally, the total number of adults having evidence of cribra orbitalia is 29 of 467 adults (4.3 %).

	Colchester, Butt Road, Essex (Pinter-Bellows, 1993)		
	n	N	%
M	6	170	3.5
F	9	140	6.4
U	5	157	3.2
J	9	108	8.3
TA	20	467	4.3
Total	29	575	5.0

Table 7.3-CO- Cribra Orbitalia at Colchester, Butt Road, Essex
(n = number of individuals affected, N =total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Data was obtained from catalogue (microfiche).

The prevalence of cribra orbitalia at the site of the Eastern Cemetery of Roman London is displayed in Table 7.4-CO. Twenty six individuals of 512 (5.0 %) were affected by cribra orbitalia. Unfortunately, no other data is provided in the skeletal report about the rate of cribra orbitalia at this site. Conheeney (2000b:283 and 285) mentions that cribra orbitalia was present but not in a very large numbers and that it was more common among the juveniles individuals.

	The Eastern Cemetery of Roman London (Conheeney, 2000a, 2000b)		
	n	N	%
M		186	
F		109	
U		88	
J		129	
TA		383	
Total	26	512	5.0

Table 7.4 CO- Cribra Orbitalia at the Eastern Cemetery of Roman, London
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.5-CO shows the prevalence of cribra orbitalia at the site of Winchester, Hampshire. Twenty eight individuals of 375 (7.5%) were affected by cribra orbitalia.

	Winchester, Hampshire (Browne, no date)		
	n	N	%
M		103	
F		76	
U		42	
J		144	
UA		10	
TA		231	
Total	28	375	7.5

Table 7.5-CO- Cribra Orbitalia at Winchester, Hampshire
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, UA= individuals of undetermined age, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Summary of Romano-British cribra orbitalia data

Table 7.6-CO and Figure 7.1-CO display the prevalence of cribra orbitalia for all the Romano-British sites. During the Romano- British period the highest prevalence of this metabolic condition is found at the site of Baldock 1 (16.2 %). At Baldock 3 in Hertfordshire the prevalence was 12.5 %. Frequencies at Winchester were lower (7.5 %). At Colchester, Butt Road, and at the Eastern Cemetery of Roman London, just 5.0 % of individuals were affected by cribra orbitalia.

	Romano-British Sites		
	n	N	%
Baldock1, Hertfordshire	31	191	16.2
Baldock 3, Hertfordshire	18	144	12.5
Colchester, Butt Road Essex	29	575	5.0
The Eastern Cemetery of Roman London	26	512	5.0
Winchester, Hampshire	28	375	7.5

Table 7.6-CO- Prevalence of cribra orbitalia for all Romano-British sites (n = number of individuals affected, N = number of individuals on site, % = percentage of individuals affected).
Note: Blank cells indicate that information was not provided by the skeletal report

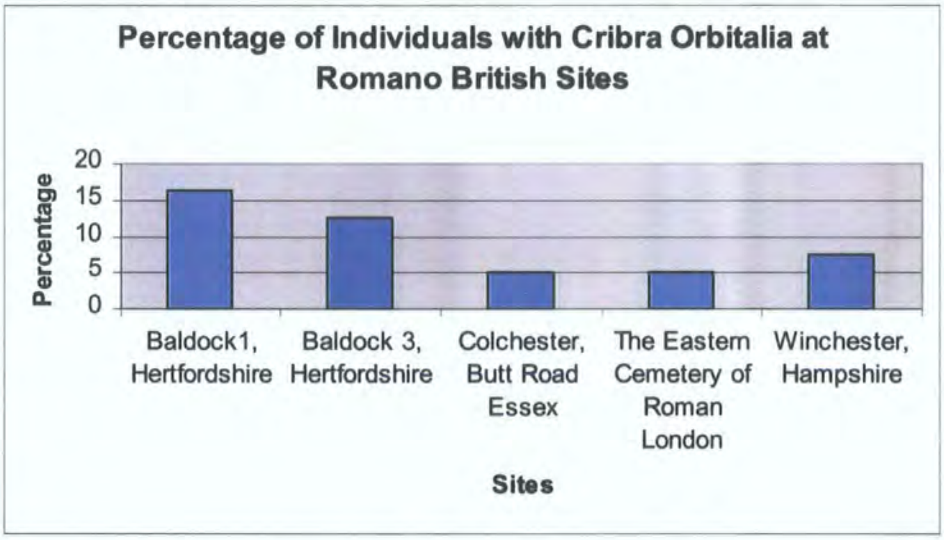


Figure 7.1-CO- Percentage of individuals with cribra orbitalia for all the Romano-British sites.

7.5.2 Early Medieval Cribra Orbitalia

Table 7.7-CO displays the prevalence rate of cribra orbitalia at the site of Great Chesterford. Four individuals of 167 (2.4 %) were affected by cribra orbitalia. Only, one female of 43 (2.3 %) was affected. Also, three juveniles of 83 (3.6%) displayed cribra orbitalia at their time of death.

	Great Chesterford, Essex (Evison, 1994; Waldron, 1994b)		
	n	N	%
M		35	
F	1	43	2.3
U		6	
J	3	83	3.6
TA		167	
Total	4	167	2.4

Table 7.7-CO- Cribra Orbitalia at Great Chesterford, Essex
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of cribra orbitalia at the site of Wicken Bonhunt can be seen in Table 7.8-CO. Twenty three individuals of 222 (10.4 %) displayed cribra orbitalia at their time of death. Two of 13 adults of undetermined sex (15.4 %) and seven of 56 juveniles (12.5 %) were diagnosed with this metabolic condition. Nine males of 94 (9.6 %) and 5 females of 59 (8.5 %) had changes in their orbits of the skull associated with cribra orbitalia. In total, sixteen adults of 166 adults (9.6 %) were affected.

	Wicken Bonhunt, Essex (Hooper, no date)		
	n	N	%
M	9	94	9.6
F	5	59	8.5
U	2	13	15.4
J	7	56	12.5
TA	16	166	9.6
Total	23	222	10.4

Table 7.8-CO- Cribra Orbitalia at Wicken Bonhunt, Essex
(n = number of individuals affected, N =total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.9-CO shows the prevalence rate of cribra orbitalia for the site of Nazeingbury, Essex. Four individuals of 154 (2.6 %) were affected by cribra orbitalia. Three males of 34 (8.8 %) and one female of 88 (1.1 %) displayed cribra orbitalia.

	Nazeingbury, Essex (Puttnam, 1978)		
	n	N	%
M	3	34	8.8
F	1	88	1.1
U		15	
J		17	
TA		137	
Total	4	154	2.6

Table 7.9-CO- Cribra Orbitalia at Nazeingbury, Essex (n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.10-CO displays the rate of cribra orbitalia at the site of Buckland, Dover. Unfortunately, most of the skulls and orbits of the skull examined were damaged by erosion prohibiting the recording of cribra orbitalia (Powers and Cullen, 1987:198).

	Buckland, Dover, Kent (Evison, 1987; Powers and Cullen, 1987)		
	N	N	%
M		54	
F		66	
U			
J		42	
TA		120	
Total		162	

Table 7.10-CO- Cribra Orbitalia at Buckland, Dover, Kent
(n = number of individuals affected, N =total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The rate of cribra orbitalia at the site of Eccles, Kent can be seen in Table 7.11-CO. Six individuals of 169 (3.6 %) displayed cribra orbitalia at their time of death. Four of 72 males (5.6 %) and 1 female of 61 (1.6 %) were affected. One juvenile of 36 (2.8 %) had cribra orbitalia. In total, five adults of 133 (3.8 %) were affected.

	Eccles, Kent (Boocock *et al.*, 1995)		
	n	N	%
M	4	72	5.6
F	1	61	1.6
U			
J	1	36	2.8
TA	5	133	3.8
Total	6	169	3.6

Table 7.11-CO- Cribra Orbitalia at Eccles, Kent (n = total number of individuals, N = number of individuals on site, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults)
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.12-CO displays the prevalence of cribra orbitalia at the site of Staunch Meadow, Brandon. Seventeen of 158 (10.8 %) were affected by cribra orbitalia. Five females of 41 (12.2 %) and six males of 57 (10.5 %) had evidence of cribra orbitalia. Four juveniles of 35 (11.4 %) and two of 25 adults of undetermined sex were affected (8.0%). In total, thirteen adults of 158 (10.8 %) had cribra orbitalia.

	Staunch Meadow, Brandon, Suffolk (Anderson, 1990)		
	n	N	%
M	6	57	10.5
F	5	41	12.2
U	2	25	8.0
J	4	35	11.4
TA	13	123	10.6
Total	17	158	10.8

Table 7.12-CO- Cribra Orbitalia at Staunch Meadow, Brandon, Suffolk
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of cribra orbitalia at the site of Edix Hill can be observed in Table 7.13-CO. Fifteen individuals of 148 (10.1 %) were diagnosed with cribra orbitalia. Seven juveniles of 46 (15.2 %) were affected. Four of 40 females (10.0 %) and four of 48 (8.3 %) had changes in their orbits of the skull consistent with this metabolic disorder. The total number of adults with cribra orbitalia is 8 adults (7.8 %). 102 adults were recovered at this site.

	Edix Hill, Barrington, Cambridgeshire (Duhig, 1998)		
	n	N	%
M	4	48	8.3
F	4	40	10.0
U		14	
J	7	46	15.2
TA	8	102	7.8
Total	15	148	10.1

Table 7.13-CO- Cribra Orbitalia at Edix Hill, Barrington, Cambridgeshire
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.14-CO shows the prevalence of cribra orbitalia at the site of North Elmham Park. Five individuals of 206 (2.4 %) were affected by cribra orbitalia. Three females of 76 (4.0 %) and one male of 82 (1.2 %) had lesions consistent with cribra orbitalia. One juvenile of 39 (2.5 %) was affected.

	North Elmham Park, Norfolk (Wells and Cayton, 1980)		
	n	N	%
M	1	82	1.2
F	3	76	4.0
U		9	
J	1	39	2.5
TA		167	
Total	5	206	2.4

Table 7.14-CO- Cribra Orbitalia at North Elmham Park, Norfolk
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.15-CO presents the prevalence of cribra orbitalia at the site of Burgh Castle, Norfolk. Four individuals of 197 (2.0 %) had cribra orbitalia. Two of 64 females (3.1 %)

and two of 79 males (2.5 %) were affected by cribra orbitalia. In total, four adults of 167 (2.4 %) were affected.

	Burgh Castle, Norfolk (Anderson and Birkett, 1991, 1993)		
	n	N	%
M	2	79	2.5
F	2	64	3.1
U		24	
J		30	
TA	4	167	2.4
Total	4	197	2.0

Table 7.15-CO- Cribra Orbitalia at Burgh Castle, Norfolk
(n = number of individuals affected, N = number of individuals on site, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Summary of Early Medieval cribra orbitalia data

Table 7.16-CO and Figure 7.2-CO display the prevalence of cribra orbitalia for all the Early Medieval sites. During this period the highest prevalence was at Staunch Meadow, Brandon (10.8 %). The frequency at Wicken Bonhunt was lower (10.4 %), followed by 10.1 % at Edix Hill, Barrington. At Eccles the rate was 3.6 %, and at Nazeingbury 2.60 %.

	Early Medieval Sites		
	n	N	%
Great Chesterford, Essex	4	167	2.4
Wicken, Bonhunt, Essex	23	222	10.4
Nazeingbury, Essex	4	154	2.6
Buckland, Dover, Kent		162	
Eccles, Kent	6	169	3.6
Staunch Meadow, Brandon, Suffolk	17	158	10.8
Edix Hill, Barrington, Cambridgeshire	15	148	10.1
North Elmham Park, Norfolk	5	206	2.4
Burgh Castle, Norfolk	4	197	2.0

Table 7.16-CO- Prevalence of Cribra Orbitalia for all Early Medieval sites
(n = number of individuals affected, N = number of individuals on site, % = percentage of individuals affected)

Frequencies at the site of North Elmham Park in Norfolk were lower (2.4 %), followed by 2.4 % at Great Chesterford. The lowest prevalence of cribra orbitalia was at Burgh Castle (2.0 %).

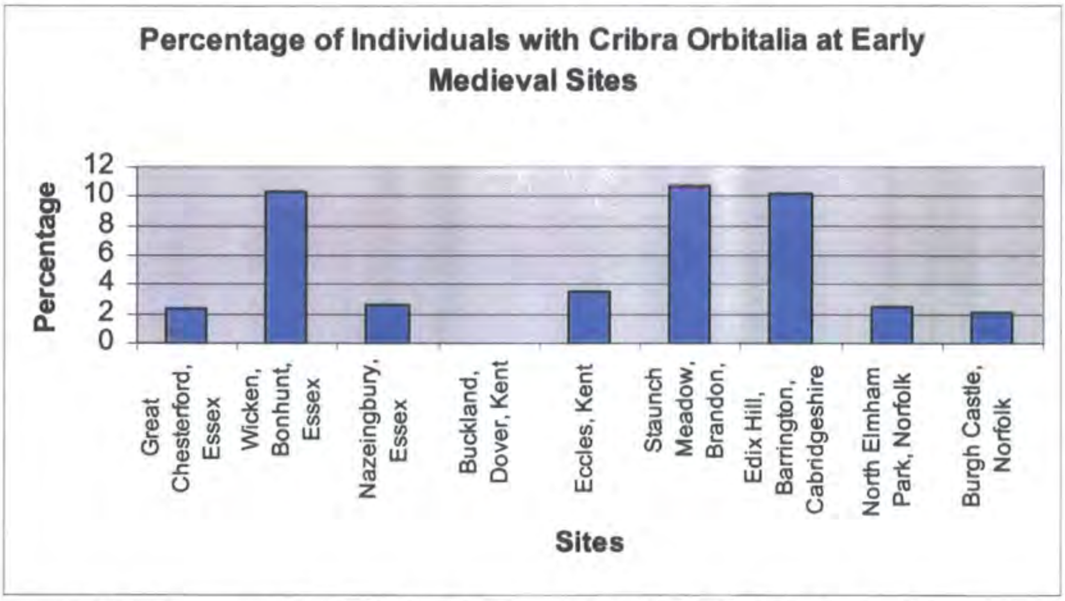


Figure 7.2-CO- Percentage of individuals with cribra orbitalia for all the Early Medieval sites

7.5.3 Late Medieval Cribra Orbitalia

Table 7.17-CO displays the prevalence of cribra orbitalia at the Late Medieval site of Blackfriars Friary, Ipswich. Forty one individuals of 250 (16.4 %) were diagnosed with cribra orbitalia. Twenty eight of 148 males (18.9 %) and nine females of 64 (14.1 %) were affected. Four juveniles of 24 (16.7 %) had cribra orbitalia. In total, thirty seven adults of 226 (16.4 %) were affected by cribra orbitalia

	Blackfriars Friary, Ipswich, Suffolk (Mays, 1991)		
	n	N	%
M	28	148	18.9
F	9	64	14.1
U		14	
J	4	24	16.7
TA	37	226	16.4
Total	41	250	16.4

Table 7.17-CO- Cribra Orbitalia at Blackfriars Friary, Ipswich, Suffolk
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The rate of cribra orbitalia at the Late Medieval site of St. James and St. Mary Magdalene Hospital, Chichester can be seen in Table 7.18-CO. Eighty one individuals of 384 (21.1 %) were affected by cribra orbitalia.

	St. James and St Mary Magdalene Hospital, Chichester, Sussex (Lee and Magilton, 1989; Magilton and Lee, 1989)		
	n	N	%
M		191	
F		75	
U		18	
J		100	
TA		284	
Total	81	384	21.1

Table 7.18-CO- Cribra Orbitalia at St. James and St Mary Magdalene Hospital, Chichester, Sussex
(n = number of individuals affected, N =total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.19-CO shows the prevalence of cribra orbitalia at the Late Medieval site of Royal Mint, St Mary Graces Priory. Thirty four individuals of 934 (3.6 %) were affected by cribra orbitalia. Sixteen juveniles of 244 (6.6 %) were affected. Ten females of 249 (4.0 %) and six males of 376 (1.6 %) were diagnosed with this disorder. The rate of adults of undetermined sex who displayed cribra orbitalia is 3.1 % (2 adults of undetermined sex of

65). In total, eighteen adults of 690 (2.6 %) have pitting in the orbits of the skull consistent with cribra orbitalia.

	Royal Mint, St Mary Graces Priory, London (Waldron, 1993)		
	n	N	%
M	6	376	1.6
F	10	249	4.0
U	2	65	3.1
J	16	244	6.6
TA	18	690	2.6
Total	34	934	3.6

Table 7.19-CO- Cribra Orbitalia at Royal Mint, St Mary Graces Priory, London
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of cribra orbitalia at the site of St. Nicholas Shambles, London can be found in Table 7.20-CO. Twenty individuals of 234 (8.6 %) were affected by cribra orbitalia. Four adults of undetermined sex of 21 (19.0 %) were affected. Nine males of 90 (10.0 %) and seven females of 77 (10.0 %) have lesions in the orbits of the skull consistent with cribra orbitalia. Twenty individuals of 188 (10.6 %) had cribra orbitalia.

	St. Nicholas Shambles, London (White, 1988)		
	n	N	%
M	9	90	10.0
F	7	77	10.0
U	4	21	19.0
J		46	
TA	20	188	10.6
Total	20	234	8.6

Table 7.20-CO- Cribra Orbitalia at St. Nicholas Shambles, London
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.21-CO gives the prevalence of cribra orbitalia at the site of Spitalfields Market. Thirty four individuals of 200 (9.0 %) were affected by cribra orbitalia. Eleven of 32 juveniles (34.4 %) had cribra orbitalia. Twenty three adults of 168 (13.7 %) had lesions associated with cribra orbitalia.

	Spitalfields Market, London (Connell, 2002; Conheeney, 1997)		
	n	N	%
M		83	
F		76	
U		9	
J	11	32	34.4
TA	23	168	13.7
Total	34	200	9.0

Table 7.21-CO- Cribra Orbitalia at Spitalfields Market, London
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of cribra orbitalia at the site of Thetford, Norfolk can be seen in Table 7.22-CO. Fifteen individuals of 149 (10.1 %) had cribra orbitalia. Thirteen juveniles of 62 (21.0 %) and two males of 19 (10.5 %) had lesions in their orbits of the skull consistent with cribra orbitalia. Lesions varied from moderate to most severe (Stroud, 1993).

	Thetford, Norfolk (Stroud, 1993)		
	n	N	%
M	2	19	10.5
F		21	
U		47	
J	13	62	21.0
TA		87	
Total	15	149	10.1

Table 7.22-CO- Cribra Orbitalia at Thetford, Norfolk
(n = number of individuals affected, N =total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.
Note: Cribra orbitalia information obtained from microfiche.

Table 7.23-CO shows the prevalence of cribra orbitalia at the site of Stratford Langthorne Abbey. Twenty two individuals of 647 (4.7 %) displayed cribra orbitalia at their time of death. Levels varied from mild to moderate severity of cribra orbitalia (Stuart-Macadam, 1986; White, 1999:8).

	Stratford Langthorne Abbey, Essex (White, 1999; Stuart-Macadam (1985b, 1986)		
	n	N	%
M		536	
F		28	
U		55	
J		28	
TA		619	
Total	22	647	4.7

Table 23-CO- Cribra Orbitalia at Stratford Langthorne Abbey, Essex
(n = number of individuals affected, N =total number of individuals, % = percentage of individuals affected
M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Summary of Late Medieval cribra orbitalia data

Table 7.24-CO and Figure 7.3-CO display the prevalence of cribra orbitalia for all the Late Medieval sites. The highest prevalence was found at St. James and St. Mary Magdalene Hospital, Chichester (21.1 %). At Blackfriars Friary, Ipswich (16.4 %) individuals were affected. At Thetford in Norfolk the rate of cribra orbitalia was 10.1 % and at Spitalfields Market in London 9.0 %, followed by St. Nicholas Shambles in London (8.6 %). Frequencies at Stratford Langthorne Abbey were much lower (4.7 %), but the lowest rate was seen at the site of Royal Mint, St Mary Graces Priory (3.6 %).

	Late Medieval Sites		
	n	N	%
Blackfriars Friary, Ipswich, Suffolk	41	250	16.4
St .James and St. Mary Magdalene Hospital, Chichester, Sussex	81	384	21.1
Royal Mint, St Mary Graces Priory, London	34	934	3.6
St Nicholas Shambles, London	20	234	8.6
Spitalfields Market, London	34	200	9.0
Thetford, Norfolk	15	149	10.1
Stratford Langthorne Abbey, Essex	22	647	4.7

Table 7.24-CO- Prevalence of Cribra Orbitalia at all the Late Medieval sites.
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA =Total Adults)

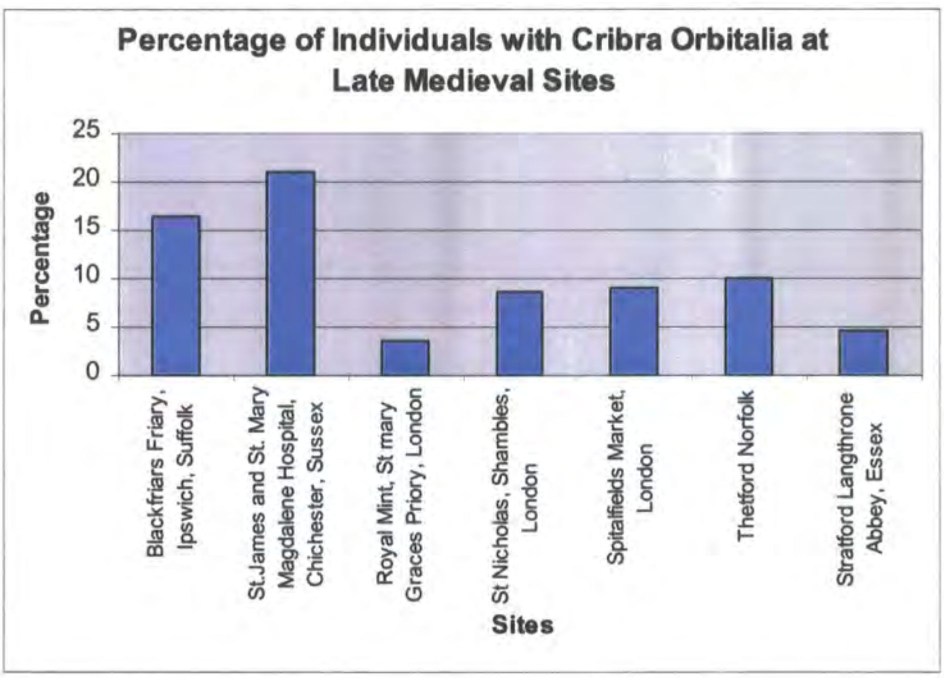


Figure 7.3-CO- Prevalence of Cribra Orbitalia for all the Late Medieval sites.

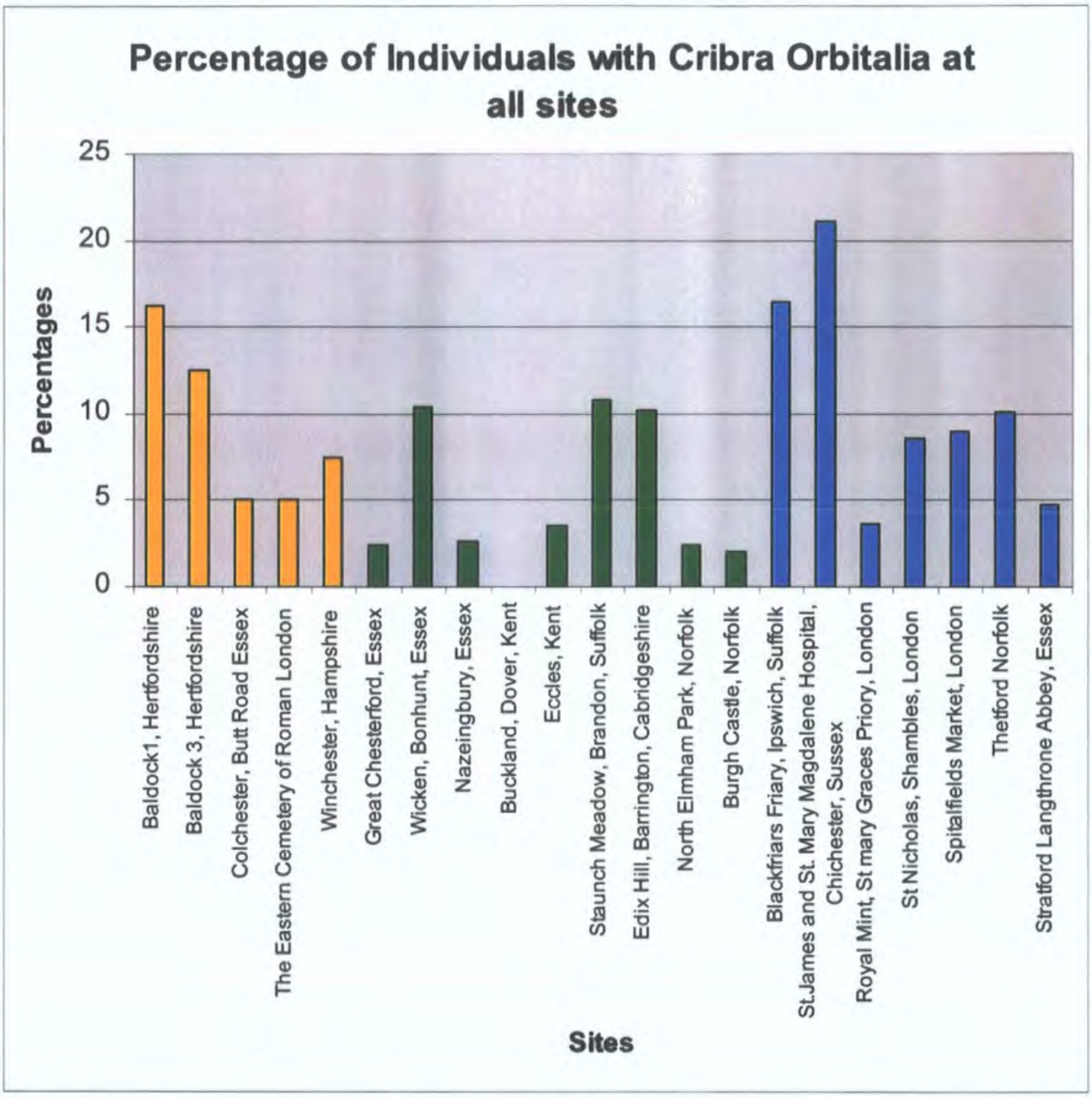
7.5.4 Cribra Orbitalia: All periods

Figure 7.4-CO displays the prevalence of cribra orbitalia for all the sites studied. The highest rate is at the Late Medieval site of St. James and St. Mary Magdalene Hospital, Chichester (21.1 %). Frequencies at the Late Medieval site of Blackfriars Friary, Ipswich were lower (16.4 %). At the Romano-British site of Baldock 1 the prevalence was 16.2 %

and at the Romano-British site of Baldock 3 (12.5 %). Three Early Medieval sites follow: Staunch Meadow, Brandon (10.8 %), Wicken Bonhunt (10.4 %) and Edix Hill, Barrington (10.1 %).

At the Late Medieval site of Thetford, 10.1 % of individuals were affected, at the Late Medieval site of Spitalfields Market (9.0 %) and at the Late Medieval site of St. Nicholas Shambles, London (8.6 %). Three Romano-British sites are next with a prevalence of 7.5 % (Winchester), 5.0 % (Colchester, Butt Road) and 5.0 % (The Eastern Cemetery of Roman London).

At the Late Medieval sites of Stratford Langthorne Abbey and at Royal Mint, St. Mary Graces Priory the frequency was 4.7 % and 3.6 %, respectively. Lower rates were found at five Early Medieval sites: Eccles (3.6 %), Nazeingbury (2.6 %), North Elmham Park (2.4 %), Great Chesterford (2.4 %) and the lowest prevalence was found at the Early Medieval site of Burgh Castle (2.0 %).



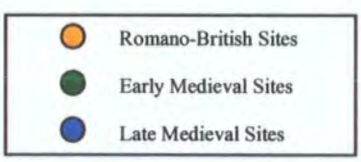


Figure 7.4-CO- Prevalence of cribra orbitalia for all the sites studied.

Table 7.25-CO and Figure 7.5-CO display the overall prevalence of cribra orbitalia for pooled Romano-British, Early and Late Medieval sites. Of the three periods the highest rate occurred during the Late Medieval period (10.5 %). During the Romano-British period the frequency was 9.3 %, but the lowest prevalence of cribra orbitalia was found during the Early Medieval period (5.5 %). Cribra orbitalia distribution by individual affected was not

significantly different between the Romano-British and the Early Medieval periods (X^2 = 0.292, p<1, d.f. = 1) and was statistically significant between the Early Medieval and the Late Medieval periods (X^2 = 15.175, p<0.001, d.f. = 1).

Differences in cribra orbitalia prevalence by individual affected between the three periods were found to be statistically significant (X^2 = 22.2829, p<0.001, d.f. = 2). When comparing the prevalence between the three periods, there is a slight, but not significant, decrease from the Romano-British period to the Early Medieval period and an increase again during the Late Medieval period.

Period	% of Individuals Affected
Romano-British Sites	9.3
Early Medieval Sites	5.5
Late Medieval Sites	10.5

Table 7.25-CO- Prevalence of cribra orbitalia by period

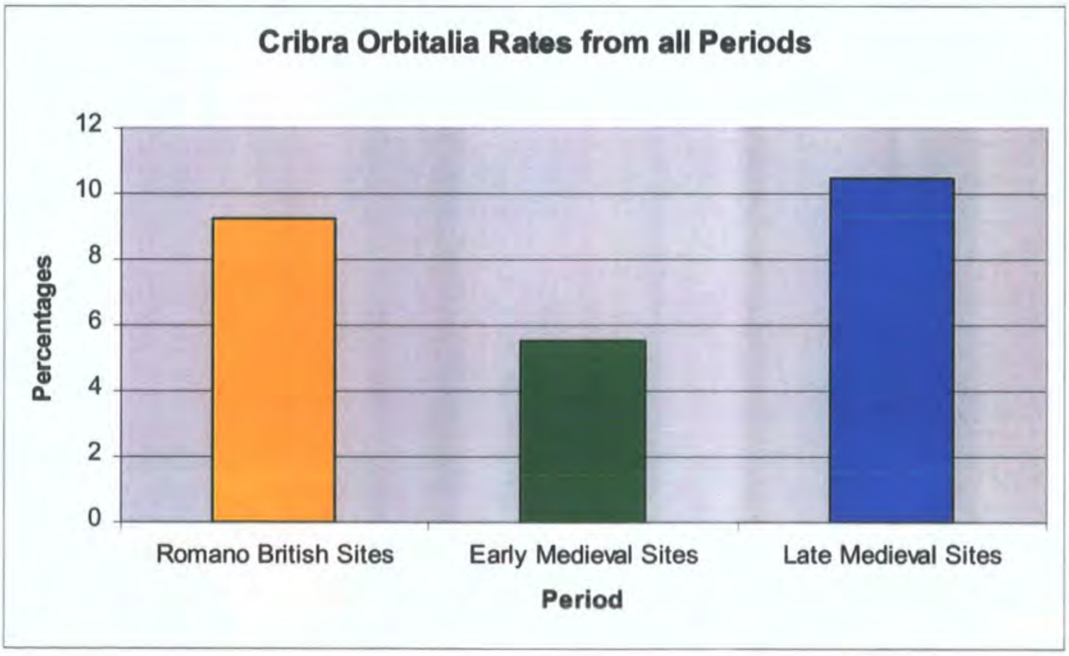


Figure 7.5-CO- Prevalence of cribra orbitalia by period.

7.6 Tibial Periostitis (TP)

7.6.1 Romano British Tibial Periostitis

Table 7.1-TP displays the prevalence of tibial periostitis at the site of Baldock 1. Twelve of 191 individuals (6.3 %) were affected by tibial periostitis. Eight males of 74 (10.8 %) and three of 50 females (6.0 %) showed signs of infection on the tibiae. One juvenile of 62 (1.6 %) was affected. In total, 11 adults of 129 (8.5 %) showed periosteal reactions consistent with periostitis.

	Baldock 1, Hertfordshire (McKinley, 1993)		
	n	N	%
M	8	74	10.8
F	3	50	6.0
U		5	
J	1	62	1.6
TA	11	129	8.5
Total	12	191	6.3

Table 7.1-TP- Tibial periostitis at Baldock 1, Hertfordshire
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of tibial periostitis at the site of Baldock 3 is presented in Table 7.2-TP. Eight individuals of 144 (5.6 %) were affected. Three adults of undetermined sex of 21 (14.3 %) had tibial periostitis. Three males of 45 (6.7 %) and two of 63 females (3.2 %) showed signs of infection on the tibiae. In total, eight adults of 129 (6.2 %).

	Baldock 3, Hertfordshire (Roberts, 1984)		
	n	N	%
M	3	45	6.7
F	2	63	3.2
U	3	21	14.3
J		15	
TA	8	129	6.2
Total	8	144	5.6

Table 7.2-TP- Tibial periostitis at Baldock 3, Hertfordshire
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.
Note: Some tibiae were eroded which contributed to the loss of information.

The Prevalence of tibial periostitis at the site of Colchester, Butt Road is shown in Table 7.3-TP. Seven of 575 individuals (0.9 %) had tibial periostitis. Six of 170 males (3.5 %) and one of 140 females (0.7 %) were affected by this non-specific infection. Seven adults of 467 (1.5 %) displayed tibial periostitis at their time of death.

	Colchester, Butt Road, Essex (Pinter-Bellows, 1993)		
	n	N	%
M	6	170	3.5
F	1	140	0.7
U		157	
J		108	
TA	7	467	1.5
Total	7	575	0.9

Table 7.3-TP- Tibial periostitis at Colchester, Butt Road, Essex
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.4-TP displays the rate of tibial periostitis at the site of The Eastern Cemetery of Roman London. Fifty one individuals of 512 (10.0 %) were affected by tibial periostitis.

	The Eastern Cemetery of Roman London (Conheeney, 2000a, 2000b)		
	n	N	%
M		186	
F		109	
U		88	
J		129	
TA		383	
Total	51	512	10.0

Table 7.4-TP- Tibial periostitis at The Eastern Cemetery of Roman, London
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.5-TP shows the prevalence of tibial periostitis at the site of Winchester. Unfortunately, no information regarding the incidence of periostitis on the tibiae at this site was given in the skeletal report.

	Winchester, Hampshire (Browne, no date)		
	n	N	%
M		103	
F		76	
U		42	
J		144	
UA		10	
TA		231	
Total		375	

Table 7.5-TP- Tibial periostitis at Winchester, Hampshire
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, UA = adults of undetermined age, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Summary of Romano-British tibial periostitis data

The prevalence of tibial periostitis for all the Romano-British sites is found in Table 7.6-TP. During the Romano-British period, the highest frequency was found at the site of the Eastern Cemetery of Roman London (10.0 %). At Baldock 1 the prevalence was 6.3 %, closely followed by Baldock 3 (5.6 %). The lowest prevalence was found at the site of

Colchester, Butt Road (0.9 %). Figure 7.1-TP shows the prevalence of tibial periostitis for all the Romano-British sites.

	Romano-British Sites		
	n	N	%
Baldock1, Hertfordshire	12	191	6.3
Baldock 3, Hertfordshire	8	144	5.6
Colchester, Butt Road Essex	7	575	0.9
The Eastern Cemetery of Roman London	51	512	10.0
Winchester, Hampshire		375	

Table 7.6-TP-Tibial periostitis for all Romano-British sites
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

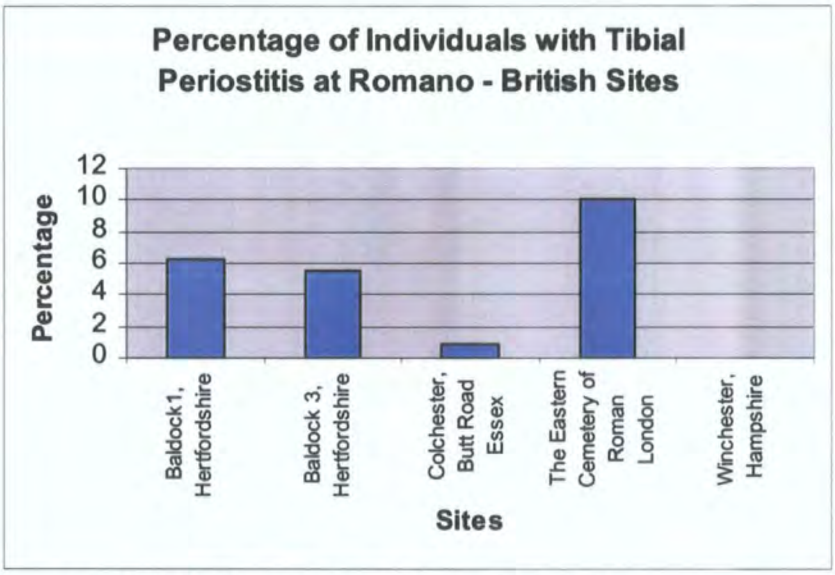


Figure 7.1-TP- Tibial Periostitis for all Romano-British sites

7.6.2 Early Medieval Tibial Periostitis

Table 7.7-TP displays the prevalence of tibial periostitis at the site of Great Chesterford. Only, one individual of 167 (0.6 %) was affected by tibial periostitis. One male of 35 (2.9 %) was affected.

	Great Chesterford, Essex (Evison, 1994; Waldron, 1994b)		
	n	N	%
M	1	35	2.9
F		43	
U		6	
J		83	
TA			
Total	1	167	0.6

Table 7.7-TP- Tibial Periostitis at Great Chesterford, Essex
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The rate of tibial periostitis at the site of Wicken Bonhunt is presented in Table 7.8-TP. Nineteen individuals of 222 (8.6 %) were affected by inflammation of the periosteum of the tibiae. Three adults of undetermined sex of 13 (23.1 %) were affected. Thirteen males of 94 (13.8 %) and three females of 59 (5.1 %) had tibial periostitis. In total, nineteen adults of 166 (11.5 %) were affected.

	Wicken Bonhunt, Essex (Hooper, no date)		
	n	N	%
M	13	94	13.8
F	3	59	5.1
U	3	13	23.1
J		56	
TA	19	166	11.5
Total	19	222	8.6

Table 7.8-TP- Tibial Periostitis at Wicken Bonhunt, Essex
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.9-TP presents the rate of periostitis of the tibiae at the site of Nazeingbury. Unfortunately, no information regarding the prevalence of tibia periostitis was given in the skeletal report.

	Nazeingbury, Essex (Puttnam, 1978)		
	n	N	%
M		34	
F		88	
U		15	
J		17	
TA		137	
Total		154	

Table 7.9-TP- Tibial Periostitis at Nazeingbury, Essex (n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.10-TP displays the prevalence of tibial periostitis at the site of Buckland, Dover. Unfortunately, no information is given in the skeletal report about the prevalence of tibia periostitis.

	Buckland, Dover, Kent (Evison, 1987; Powers and Cullen, 1987)		
	n	N	%
M		54	
F		66	
U			
J		42	
TA		120	
Total		162	

Table 7.10-TP- Tibial Periostitis at Buckland, Dover, Kent
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The rate of tibial periostitis at the site of Eccles is presented in Table 7.11-TP. Unfortunately, no information is presented in the skeletal report about the prevalence of periostitis of the tibiae at this site.

	Eccles, Kent (**Boocock** ***et al.*****, 1995**)		
	n	N	%
M		72	
F		61	
U			
J		36	
TA		133	
Total		169	

Table 7.11-TP- Tibial Periostitis at Eccles, Kent (n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.12-TP shows the rate of tibial periostitis at the site of Staunch Meadow, Brandon. Sixteen of 158 individuals were affected by tibial periostitis (10.1 %). Seven females of 41 (17.1 %) and seven males of 57 (12.3%) were affected by this non-specific infection. Two of 25 adults of undetermined sex (8.0 %) were affected. In total, sixteen adults of 123 (13.0 %) had tibial periostitis.

	Staunch Meadow, Brandon, Suffolk (Anderson, 1990)		
	n	N	%
M	7	57	12.3
F	7	41	17.1
U	2	25	8.0
J		35	
TA	16	123	13.0
Total	16	158	10.1

Table 7.12-TP- Tibial Periostitis at Staunch Meadow, Brandon, Suffolk
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.13-TP displays the prevalence of tibial periostitis at the site of Edix Hill, Barrington. Five individuals of 148 (3.4 %) were affected by tibial periostitis. Three females of 40 (7.5 %) and two males of 48 (4.2 %) showed inflammation of the periosteum of the tibiae.

	Edix Hill, Barrington, Cambridgeshire (Duhig, 1998)		
	n	N	%
M	2	48	4.2
F	3	40	7.5
U		14	
J		46	
TA		102	
Total	5	148	3.4

Table 7.13-TP- Tibial Periostitis at Edix Hill, Barrington, Cambridgeshire
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of tibial periostitis at the site of North Elmham Park is shown in Table 7.14-TP. Ten individuals of 206 (4.9 %) were affected by tibial periostitis. One adult of undetermined sex of 9 (11.1 %) was affected. Eight males of 82 (9.8 %) and one female of 76 (1.3 %) showed signs of infection and inflammation on the tibiae. Ten adults of 167 (6.0 %) had tibial periostitis.

	North Elmham Park, Norfolk (Wells and Cayton, 1980)		
	n	N	%
M	8	82	9.8
F	1	76	1.3
U	1	9	11.1
J		39	
TA	10	167	6.0
Total	10	206	4.9

Table 7.14-TP- Tibial Periostitis at North Elmham Park, Norfolk
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.15-TP displays the prevalence of tibial periostitis at the site of Burgh Castle, Norfolk. Twelve individuals of 197 (6.1 %) had tibial periostitis. Four adults of undetermined sex of 24 (16.7 %) were affected. Four females of 64 (6.3 %) and four of 79 males (5.1 %) showed tibial periostitis. In total, twelve adults of 167 (7.2 %) were affected.

	Burgh Castle, Norfolk (Anderson and Birkett, 1991, 1993)		
	n	N	%
M	4	79	5.1
F	4	64	6.3
U	4	24	16.7
J		30	
TA	12	167	7.2
Total	12	197	6.1

Table 7.15-TP- Tibial Periostitis at Burgh Castle, Norfolk
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA – Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.
Note: Tibial periostitis information obtained from catalogue.

Summary of Early Medieval tibial periostitis data

The prevalence of tibial periostitis for all the Early Medieval sites is found in Table 7.16-TP. During this period, the highest frequency was found at Staunch Meadow, Brandon (10.1 %). At Wicken Bonhunt the rate was (8.6 %), followed by Burgh Castle (6.1 %). At North Elmham Park the prevalence was (4.9 %) and at Edix Hill, Barrington was 3.4 %. The lowest prevalence was found at the site of Great Chesterford (0.6 %). Figure 7.2-TP shows the prevalence of tibial periostitis during the Early Medieval period.

	Early Medieval Sites		
	n	N	%
Great Chesterford, Essex	1	167	0.6
Wicken Bonhunt, Essex	19	222	8.6
Nazeingbury, Essex		154	
Buckland, Dover, Kent		162	
Eccles, Kent		169	
Staunch Meadow, Brandon, Suffolk	16	158	10.1
Edix Hill, Barrington, Cambridgeshire	5	148	3.4
North Elmham Park, Norfolk	10	206	4.9
Burgh Castle, Norfolk	12	197	6.1

Table 7.16-TP- Tibial Periostitis at all Early Medieval sites
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected).
Note: Blank cells indicate that information was not provided by the skeletal report.

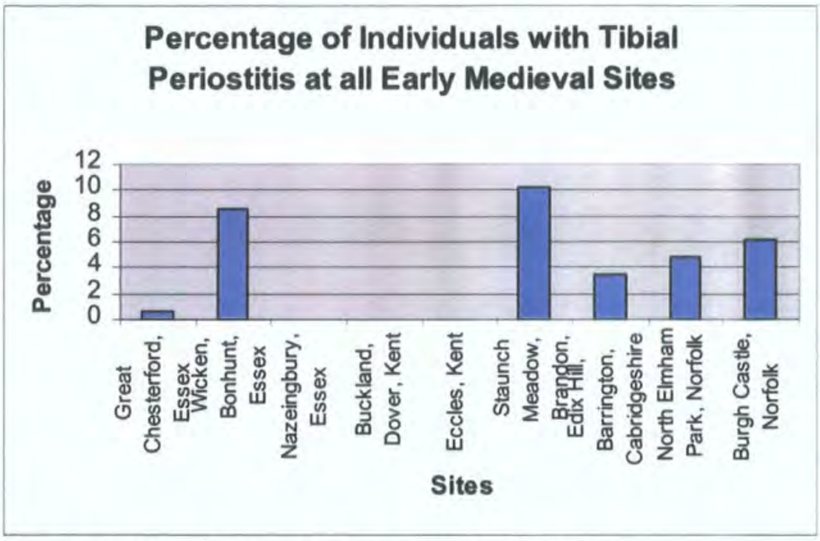


Figure 7.2-TP- Tibial Periostitis for all Early Medieval sites

7.6.3 Late Medieval Tibial Periostitis

Table 7.17-TP shows the rate of tibial periostitis at the Late Medieval site of Blackfriars Friary, Ipswich. Twenty seven individuals of 250 (10.8 %) were affected by tibial periostitis.

	Blackfriars Friary, Ipswich, Suffolk (Mays, 1991)		
	n	N	%
M		148	
F		64	
U		14	
J		24	
TA		226	
Total	27	250	10.8

Table 7.17-TP- Tibial Periostitis at Blackfriars Friary, Ipswich, Suffolk
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of tibial periostitis at the site of St. James and St. Mary Magdalene Hospital, Chichester is shown in Table 7.18-TP. One hundred and twenty eight individuals of 384 (33.3 %) were affected by tibial periostitis.

	St .James and St Mary Magdalene Hospital, Chichester, Sussex (Lee and Magilton, 1989; Magilton and Lee, 1989)		
	n	N	%
M		191	
F		75	
U		18	
J		100	
TA		284	
Total	128	384	33.3

Table 7.18-TP- Tibial Periostitis at St. James and St Mary Magdalene Hospital, Chichester, Sussex (n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.19-TP displays the prevalence of tibial periostitis at the site of Royal Mint, St Mary Graces Priory. Unfortunately, no information regarding tibial periostitis at this site was given in the skeletal report.

	Royal Mint, St Mary Graces Priory, London (Waldron, 1993)		
	n	N	%
M		376	
F		249	
U		65	
J		244	
TA		690	
Total		934	

Table 7.19-TP- Tibial Periostitis at Royal Mint, St Mary Graces Priory, London
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

The prevalence of tibial periostitis at the site of St. Nicholas Shambles is shown in Table 7.20-TP. White (1988:43) mentions that there are large amounts of people with periostitis, but no detail data are provided to support this statement.

	St. Nicholas Shambles, London (White, 1988)		
	n	N	%
M		90	
F		77	
U		21	
J		46	
TA		188	
Total		234	

Table 7.20-TP- Tibial Periostitis at St. Nicholas Shambles, London
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.21-TP displays the prevalence of tibial periostitis at the site of Spitalfields Market. Eighteen individuals of 200 (9.0 %) were affected by tibial periostitis.

	Spitalfields Market, London (Connell, 2002; Conheeney, 1997)		
	n	N	%
M		83	
F		76	
U		9	
J		32	
TA		168	
Total	18	200	9.0

Table 7.21-TP- Tibial Periostitis at Spitalfields Market, London
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Table 7.22-TP displays the rate of tibial periostitis at the site of Thetford, Norfolk. Four individuals of 149 (2.7 %) were affected by tibial periostitis. Three males of 19 (15.8 %) and one female of 21 (4.8 %) showed changes on the tibiae associated with tibial periostitis.

	Thetford, Norfolk (Stroud, 1993)		
	n	N	%
M	3	19	15.8
F	1	21	4.8
U		47	
J		62	
TA		87	
Total	4	149	2.7

Table 7.22-TP- Tibial Periostitis at Thetford, Norfolk
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.
Note: Tibial periostitis information obtained from microfiche.

The prevalence of tibial periostitis at the site of Stratford Langthorne Abbey can be seen in Table 7.23-TP. White (1999:15) mentions that there is a high proportion of lower leg infection in lay brothers and that males showed severe periostitis of both tibiae. However, no detail data is provided in the skeletal reports about the rate of periostitis of the tibiae in any of the specific group of people.

	Stratford Langthorne Abbey, Essex (White, 1999; Stuart-Macadam (1985b, 1986)		
	n	N	%
M		536	
F		28	
U		55	
J		28	
TA		619	
Total		647	

Table 7.23-TP- Tibial Periostitis at Stratford Langthorne Abbey, Essex
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

Summary of Late Medieval tibial periostitis data

The prevalence of tibial periostitis for all the Late Medieval sites is found in Table 7.24-TP. The highest frequency was found at the site of St. James and St. Mary Magdalene Hospital (33.3 %). At Blackfriars Friary, Ipswich the prevalence was 10.8 %, closely followed by

Spitalfields Market in London (9.0 %). The lowest frequency was at Thetford in Norfolk (2.7 %). Figure 7.3-TP shows the incidence of tibial periostitis during the Late Medieval period.

	Late Medieval Sites		
Site Name	n	N	%
Blackfriars Friary, Ipswich, Suffolk	27	250	10.8
St. James and St. Mary Magdalene Hospital, Chichester, Sussex	128	384	33.3
Royal Mint, St Mary Graces Priory, London		934	
St Nicholas Shambles, London		234	
Spitalfields Market, London	18	200	9.0
Thetford, Norfolk	4	149	2.7
Stratford Langthorne Abbey, Essex		647	

Table 7.24-TP- Tibial Periostitis at all Late Medieval Sites
(n = number of individuals affected, N = total number of individuals, % = percentage of individuals affected, M = male adults, F = Female adults, U = adult of undetermined sex, J = juvenile, TA = Total Adults).
Note: Blank cells indicate that information was not provided by the skeletal report.

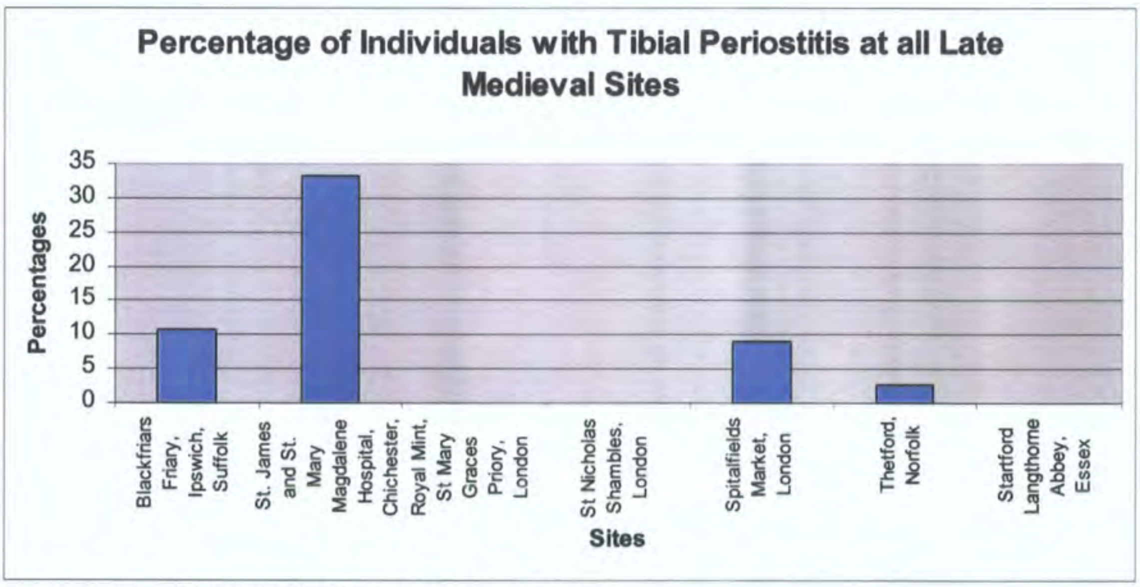


Figure 7.3-TP- Tibial Periostitis for all Late Medieval Sites.

7.6.4 Tibial Periostitis: All periods

Figure 7.4-TP displays the prevalence of tibial periostitis for all the sites studied. The highest rate is at the Late Medieval site of St. James and St. Mary Magdalene Hospital (33.3 %). The frequency at the Late Medieval site of Blackfriars Friary, Ipswich was lower

10.8 %. At the Early Medieval site of Staunch Meadow, Brandon the prevalence was 10.1 %, and at the Romano-British site of the Eastern Cemetery of Roman London was 10.0 %. On the contrary, at the Late Medieval site of Spitalfields Market the frequency was 9.0 %, closely followed by the Early Medieval site of Wicken Bonhunt 8.6 %.

At the Romano-British site of Baldock 1 the prevalence of tibial periostitis was 6.3 %, and at the Early Medieval site of Burgh Castle was 6.1 %. At the Romano-British site of Baldock 3 5.6 % of individuals were affected and next is the Early Medieval site of North Elmham Park with a frequency of 4.9 %. At the Early Medieval site of Edix Hill, Barrington 3.4 % of individuals were affected, and at the Late Medieval site of Thetford 2.7% were affected. At the Romano-British site of Colchester Butt Road in Essex the prevalence was 0.9 %, the lowest prevalence being found at the Early Medieval site of Great Chesterford 0.6 %.

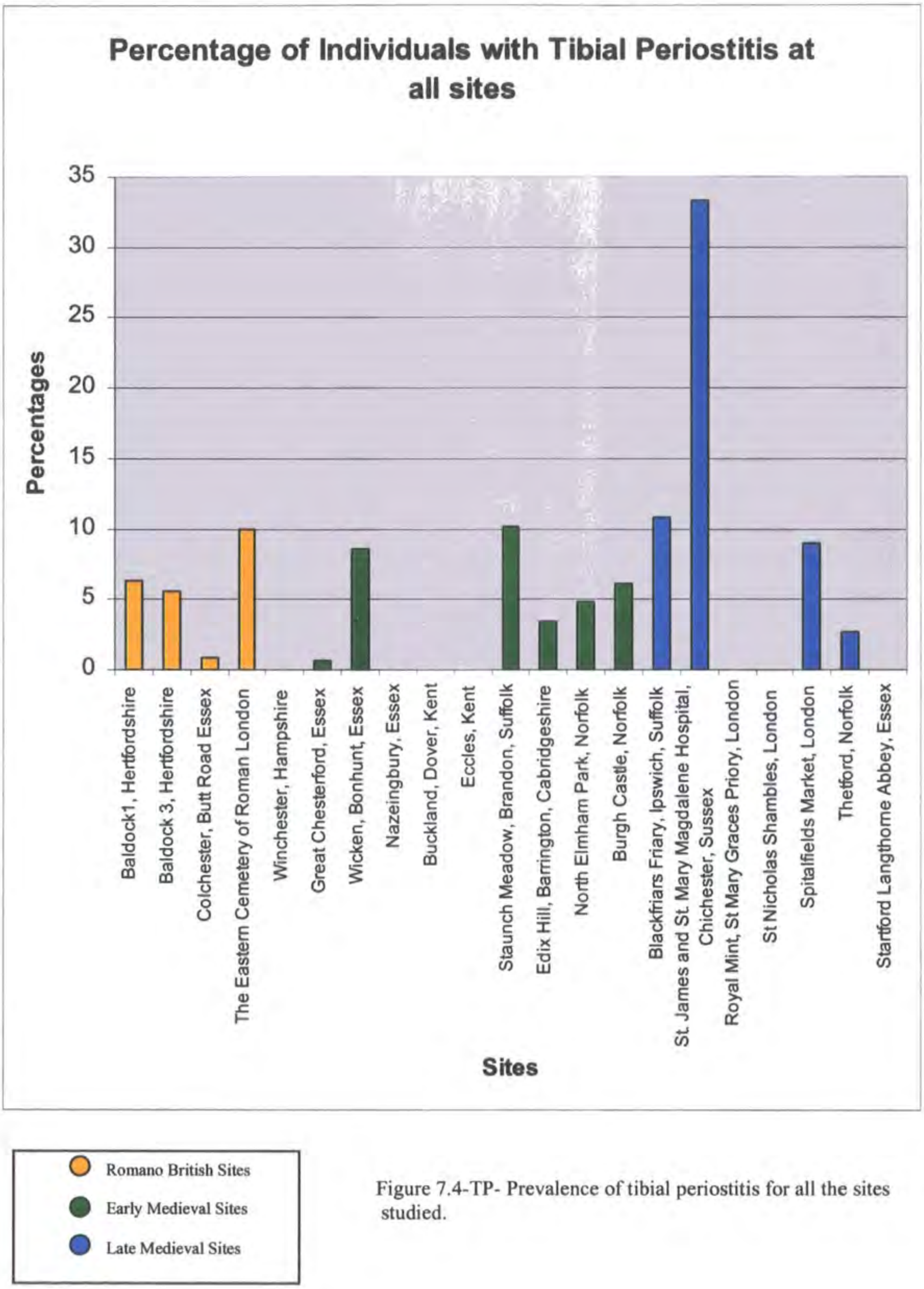


Figure 7.4-TP- Prevalence of tibial periostitis for all the sites studied.

Table 7.25-TP and Figure 7.5-TP display the overall prevalence of tibial periostitis for pooled Romano-British, Early and Late Medieval sites. Of the three periods the highest rate

occurred during the Late Medieval period (14.0 %). During the Romano-British period the frequency was 5.7 %, but the lowest prevalence of tibia periostitis was found during the Early Medieval period (5.1 %). Tibial periostitis distribution by individual affected was not significantly different between the Romano-British and the Early Medieval periods (X^2 = 0.274, p<1, d.f. = 1) and statistically significant between the Early Medieval and the Late Medieval periods (X^2 = 10.75, p<0.005, d.f. = 1). However, differences in tibial periostitis prevalence by individual affected between the three periods were found to be statistically significant (X^2 = 9.3476, p<0.01, d.f. = 2). The prevalence of individuals affected by tibial periostitis slightly decreased, but not significantly, between the Romano-British period to the Early Medieval period. However, the prevalence of individuals affected significantly increased again during the Late Medieval period.

Sites	% of Individuals Affected
Romano British Sites	5.7
Early Medieval Sites	5.1
Late Medieval Sites	14.0

Table 7.25-TP- Prevalence of tibial periostitis by period

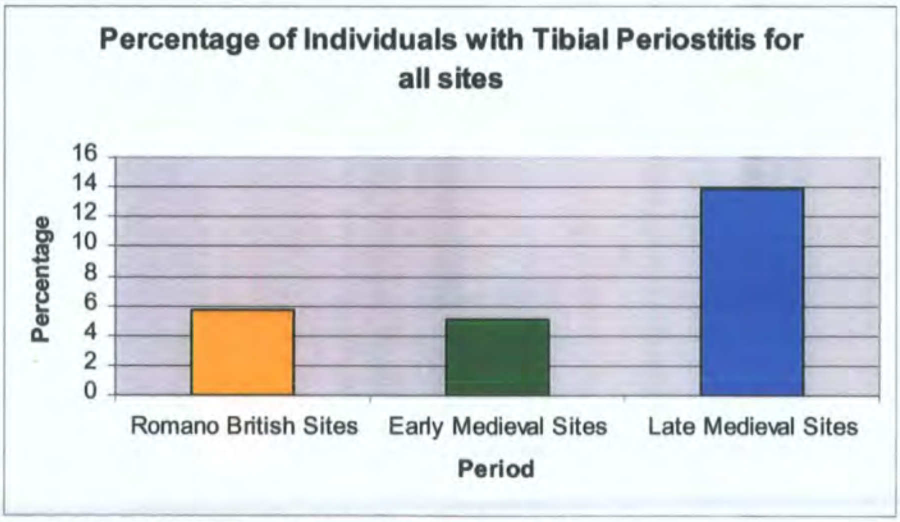


Figure 7.5-TP- Prevalence of tibial periostitis by period.

7.7 Age at Death Profile (ADP)

7.7.1 Romano British Age at death profile

No data was presented in the skeletal report for Baldock 1 for age at death. However, McKinley (1993:5) mentions that for both male and female individuals, similar median age at death was observed, which was between 26 and 45 years. Therefore, most of the individuals were among the age categories middle adult and mature adult.

Table 7.1-ADP shows the age at death profile at the site of Baldock 3. Of the 67 individuals 12 (17.9 %) were juveniles (aged below 16 years), and 55 (82.1 %) were adults of unspecified sex. Thirty two of them (58.2 %) were categorized as middle adults (26-35 years), nine (16.4 %) were young adults (16-25 years), seven (12.7 %) were classed as mature adults (36-45 years) and seven (12.7 %) were old adults (45+ years).

Baldock 3, Hertfordshire (Roberts, 1984)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**12**						**12** 17.9
Females % %*							
Males % %*							
US % %*		**9** 16.4 100	**32** 58.2 100	**7** 12.7 100	**7** 12.7 100		**55** 82.1
Total %**	**12**	**9** 16.4	**32** 58.2	**7** 12.7	**7** 12.7		**67** **(55)**

Table 7.1-ADP- Age at Death profile at Baldock 3, Hertfordshire (% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals). Note: Blank cells imply that information was not provided by the skeletal report.

The age at death profile at the site of Colchester, Butt Road is shown in Table 7.2-ADP. Of the 545 individuals 106 individuals (19.5 %) were juveniles (aged below 16 years), 170 adults of 439 (31.2 %) were males, 140 (25.7 %) were females, and 129 (23.7 %) were adults of unspecified sex. For males 88 (51.8 %) were aged as mature adults (36-45 years), 30 (17.7 %) were classified as adults of undetermined age, 29 (17.1 %) were grouped as middle adult (26-35 years), 20 (11.8 %) more males were categorized as old adults (45+ years), and three (1.8 %) were found to be young adults (16-25 years).

For females 54 (38.6 %) were mature adults (36-45 years), 35 (25.0 %) were adult of undetermined age, 34 (24.3 %) were classified as middle adults (26-35 years), 13 (9.3 %) more females were categorized as old adult (45+ years), and 4 (2.9 %) females were aged as young adults (16-25 years). The age groups and frequencies for the 129 adults of unspecified sex included: 87 (67.4 %) adults of undetermined age, 13 (10.1 %) middle adults (26-35 years), 11 (8.5 %) mature adults (36-45 years), 10 (7.8 %) old adults (45+ years), and eight (6.2 %) young adults (16-25 years).

In total, 153 (34.9 %) individuals were mature adults (36-45 years), 152 (34. 6 %) were adults of undetermined age, 76 (17.3 %) were middle aged (26-35 years), 43 (9.8 %) were categorized as old adults (45+ years), and 15 (2.3 %) were young adults (16-25 years).

Colchester, Butt Road, Essex (Pinter-Bellows, 1993)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**106**						**106** 19.5
Females % %*		**4** 2.9 26.7	**34** 24.3 44.7	**54** 38.6 35.3	**13** 9.3 30.2	**35** 25.0 23.0	**140** 25.7
Males % %*		**3** 1.8 20.0	**29** 17.1 38.2	**88** 51.8 57.5	**20** 11.8 46.5	**30** 17.7 19.7	**170** 31.2
US % %*		**8** 6.2 53.3	**13** 10.1 17.1	**11** 8.5 7.2	**10** 7.8 23.3	**87** 67.4 57.2	**129** 23.7
Total %**	**106**	**15** 2.3	**76** 17.3	**153** 34.9	**43** 9.8	**152** 34.6	**545** **(439)**

Table 7.2-ADP- Age at Death profile at Colchester, Butt Road, Essex
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

The mortality profile at the site of the Eastern Cemetery of Roman London is seen in Table 7.3-ADP. Of the 381 individuals 112 (29.4 %) were juveniles (aged below 16 years) and 269 (70.6 %) were adults of unspecified sex. One hundred and fifty nine of the adults (59.1 %) were middle adults (26-35 years), 56 (20.8 %) were young adults (16-25 years), and 54 (20.1 %) were mature adults (36-45 years).

The Eastern Cemetery of Roman London (Conheeney, 2000a, 2000b)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**112**						**112** 29.4
Females % %*							
Males % %*							
US % %*		**56** 20.8 100	**159** 59.1 100	**54** 20.1 100			**269** 70.6
Total %**	**112**	**56** 20.8	**159** 59.1	**54** 20.1			**381** **(269)**

Table 7.3-ADP- Age at Death profile at The Eastern Cemetery of Roman London
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

Table 7.4-ADP gives the age at death profile for the site of Winchester. Of the 234 individuals, 113 (48.9 %) were juveniles (aged below 16 years), and 121 individuals (51.7 %) were adults of unspecified sex. Sixty two (51.2 %) of these adults of unspecified sex were young adults (16-25 years), 34 (28.1 %) were middle adults (26-35 years), 18 (14.9 %) were mature adults (36-45 years) and seven (5.8 %) were categorize as old adults (45+ years).

Winchester, Hampshire (Browne, no date)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**113**						**113** 48.9
Females % %*							
Males % %*							
US % %*		**62** 51.2 100	**34** 28.1 100	**18** 14.9 100	**7** 5.8 100		**121** 51.7
Total %**	**113**	**62** 51.2	**34** 28.1	**18** 14.9	**7** 5.8		**234** **(121)**

Table 7.4-ADP- Age at Death profile at Winchester, Hampshire
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

Summary of Romano-British age at death data

Table 7.5-ADP and Figure 7.1-ADP shows the age at death profile for the sites considered for the Romano-British period. Of the 1227 Romano-British individuals studied, 884 adults and 343 (28.0 %) juveniles (aged below 16 years) were represented. Five hundred and seventy four adults (46.8 %) were adults of undetermined sex, 170 (13.9 %) were males and 140 (11.4 %) were females. For males, 88 (51.8 %) were mature adults (36-45 years), 30 (17.7 %) were adults of undetermined age, 29 (17.1 %) were middle adults (26-35 years), 20 (11.8 %) were old adults (45+ years), and three (1.8 %) were young adults (16-25 years).

For the females, 54 (38.6 %) were mature adults (36-45 years), 35 (25.0 %) were adults of undetermined age, 34 (24.3 %) were middle adults (26-35 years), 13 (9.3 %) were old adults (45 + years), and four (2.9 %) were young adult (16-25 years).For the adults of undetermined sex, 238 (41.5 %) were middle adults (26-35 years), 135 (23.5 %) were young adults (16-25 years), 90 (15.7 %) were mature adults (36-45 years), 87 (15.2 %) were adults of undetermined age, and 24 (4.2 %) were old adults (45 + years).

In total during the Romano-British period, 301 individuals (34.1 %) were middle adult (26-35 years), 232 (26.2 %) were mature adults (36-45 years), 152 (17.2 %) were adults of undetermined age, 142 (16.1 %) were young adults, and 57 (6.5 %) were old adults (45 + years). Figure 7.2-ADP shows age at death during the Romano-British period.

	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles	**343**						**343**
%*							28.0
Females		**4**	**34**	**54**	**13**	**35**	**140**
%		2.9	24.3	38.6	9.3	25.0	
%*		2.8	11.3	23.3	22.8	23.0	11.4
Males		**3**	**29**	**88**	**20**	**30**	**170**
%		1.8	17.1	51.8	11.8	17.7	
%*		2.1	9.6	37.9	35.1	19.7	13.9
US		**135**	**238**	**90**	**24**	**87**	**574**
%		23.5	41.5	15.7	4.2	15.2	
%*		95.1	79.1	38.8	42.1	57.2	46.8
Total	**343**	**142**	**301**	**232**	**57**	**152**	**1227**
%**		16.1	34.1	26.2	6.5	17.2	**(884)**

Table 7.5-ADP- Age at Death profile for Romano British Sites
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

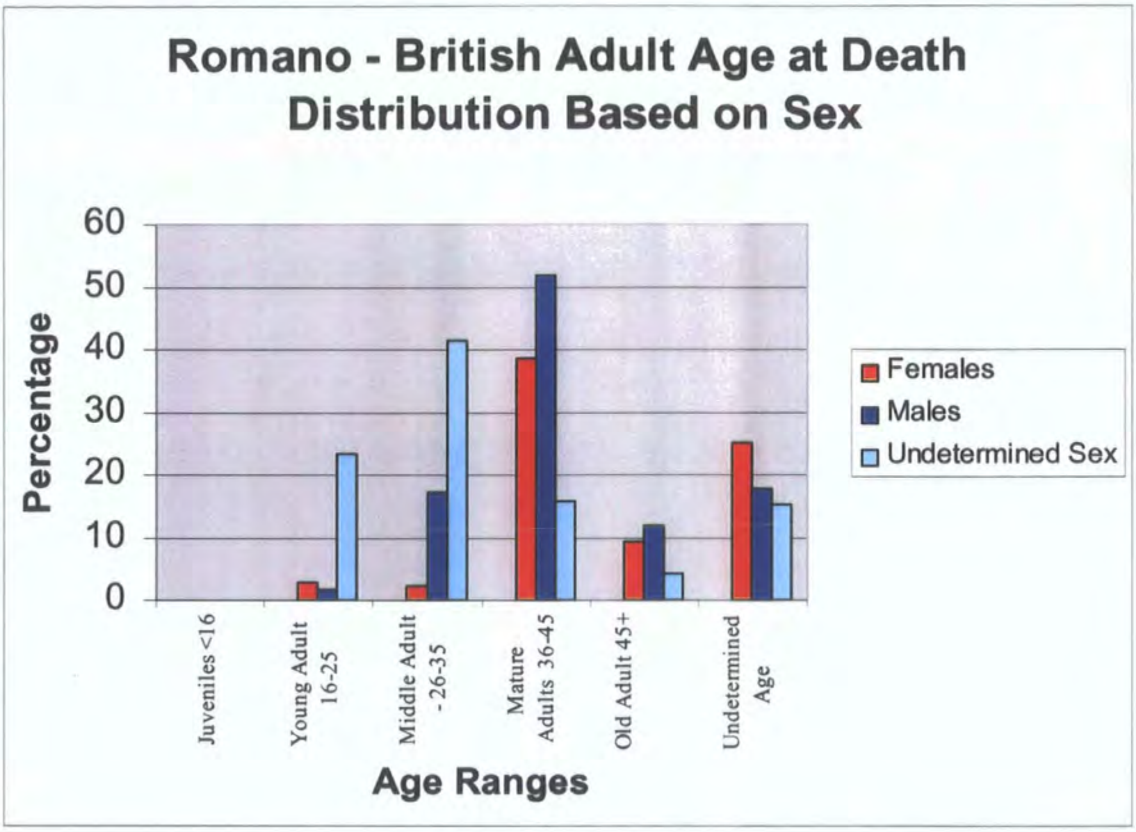


Figure 7.1-ADP- Age at Death profile for the Romano British Period, distributed by sex

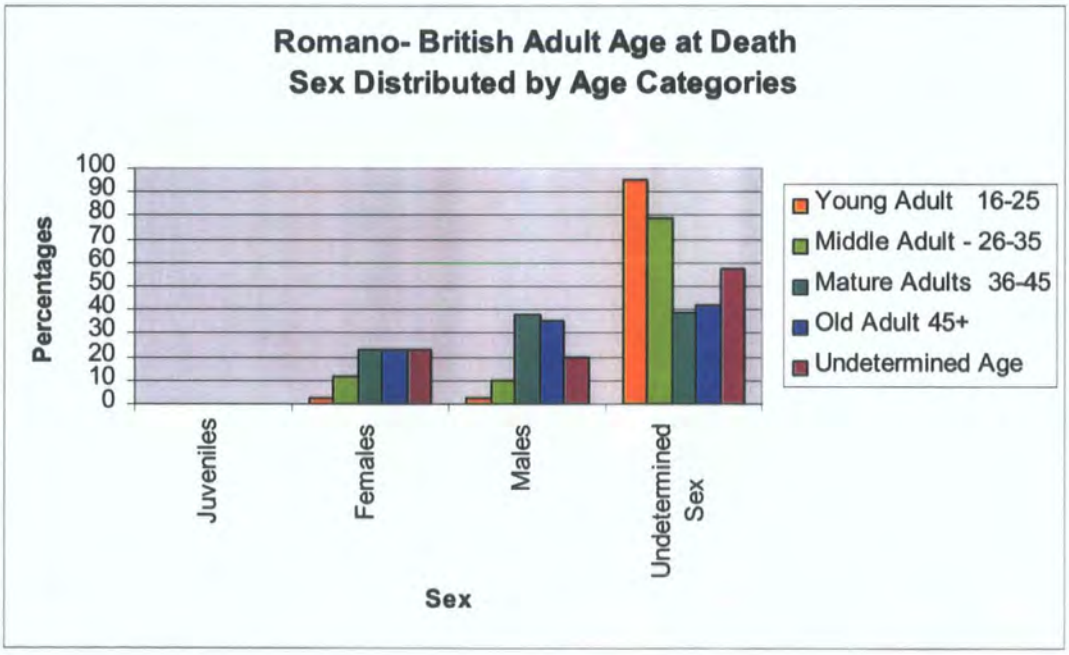


Figure 7.2-ADP- Age at Death profile for the Romano British period by age categories

7.7.2 Early Medieval Age at Death Profile

The age at death profile at the site of Great Chesterford is shown in Table 7.6-ADP. Of the 72 individuals, 16 (22.2 %t) were juveniles (aged below 16 years) and 56 were adults, of which, 33 (45.8 %) were females and 23 (31.9 %) were males. Seventeen females (51.5 %) were middle adult (26-35 years), 10 (30.3 %) were young adults (16-25 years), and six females (18.2 %) were mature adults (36-45 years). On the other hand, seven males (30.4 %) were young adults (16-25 years), eight (34.8 %) were grouped as middle adults (26-35 years), and eight (34.8 %) were mature adults (36-45 years).

In total, 25 (44.6 %) individuals were middle adult (26-35 years), 17 (30.4 %) were young adults (16-25 years), and 14 (25.0 %) were mature adults (36-45 years).

Great Chesterford, Essex (Evison, 1994; Waldron, 1994b)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**16**						**16** 22.2
Females % %*		**10** 30.3 58.8	**17** 51.5 68.0	**6** 18.2 42.9			**33** 45.8
Males % %*		**7** 30.4 41.2	**8** 34.8 32.0	**8** 34.8 57.1			**23** 31.9
US % %*							
Total %**	**16**	**17** 30.4	**25** 44.6	**14** 25.0			**72** **(56)**

Table 7.6-ADP- Age at Death profile at Great Chesterford, Essex
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

Table 7.7-ADP shows the age at death at the site of Wicken Bonhunt. Of the 171 adult individuals, 112 (65.5 %) were females, and 59 (34.5 %) were males. Thirty seven females

(40.2 %) were mature adult (36-45 years), 34 (37.0 %) were middle adult (26-35 years), 21 (22.8 %) were old adult (45+), and 20 (21.7 %) were young adult (16-25). Of the 59 males, 27 (45.8 %) were middle adult (26-35 years), 17 (28.8 %) were mature adult (36-45 years), eight (13.6 %) were old adult (45+ years), and seven (11.9 %) were young adult (16-25 years).

In total, 61 (40.4 %) individuals were middle adult (26-35 years), 54 (35.8 %) were mature adults (36-45 years), 29 (19.2 %) were old adults (45+ years), and 27 (17.9 %) individuals were young adults (16-25 years).

Wicken Bonhunt, Essex (Hooper, no date)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles							
Females % %*		**20** 21.7 74.1	**34** 37.0 55.7	**37** 40.2 68.5	**21** 22.8 72.4		**112** 65.5
Males % %*		**7** 11.9 25.9	**27** 45.8 44.3	**17** 28.8 31.5	**8** 13.6 27.6		**59** 34.5
US % %*							
Total %**		**27** 17.9	**61** 40.4	**54** 35.8	**29** 19.2		**171** **(171)**

Table 7.7-ADP- Age at Death profile at Wicken Bonhunt, Essex
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

The age at death profile at the site of Nazeingbury is shown in Table 7.8-ADP. Of the 95 individuals, 14 were juveniles (aged below 16 years), and 81were adults of unspecified sex. Thirty adults of unspecified sex (37.0 %) were middle adults (26-35 years), 29 (35.8 %) were old adults (45+ years), 12 (14.8 %) were mature adults (36-45 years), and 10 (12.4 %) were young adult (16-25 years).

Nazeingbury, Essex (Puttnam, 1978)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**14**						**14** 14.7
Females % %*							
Males % %*							
US % %*		**10** 12.4 100	**30** 37.0 100	**12** 14.8 100	**29** 35.8 100		**81** 85.3
Total %**	**14**	**10** 12.4	**30** 37.0	**12** 14.8	**29** 35.8		**95** **(81)**

Table 7.8-ADP- Age at Death profile at Nazeingbury, Essex
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

Table 7.9-ADP shows the mortality profile at the site of Buckland, Dover. Of the 85 individuals, 17 (20.0 %) were juveniles (aged below 16 years), and 68 were adults. Thirty seven (43.5 %) were females, and 31 (36.5 %) were males. Sixteen females (43.2 %) were young adults (16-25 years), 10 (27.0 %) were middle adults (26-35 years), six (16.2 %) were mature adults (36-45 years), and five (13.5 %) were classified as old adults (45+ years). Fifteen males (48.4 %) were old adults (45+ years), seven (22.6 %) were mature adults (36-45 years), seven (22.6 %) were middle adults (22.6 %), and two (6.5 %) were young adults (16-25 years).

In total, 20 (29.4 %) individuals were old adults (45+ years), 18 (26.5 %) were young adults (16-25 years), 17 (25.0 %) were middle adults (26-35 percent), and 13 (19.1 %) were mature adults (36-45 years).

Buckland, Dover, Kent (Evison, 1987; Powers and Cullen, 1987)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**17**						**17** 20.0
Females % %*		**16** 43.2 88.9	**10** 27.0 58.8	**6** 16.2 46.2	**5** 13.5		**37** 43.5
Males % %*		**2** 6.5 11.1	**7** 22.6 41.2	**7** 22.6 53.9	**15** 48.4 75.0		**31** 36.5
US % %*							
Total %**	17	**18** 26.5	**17** 25.0	**13** 19.1	**20** 29.4		**85** **(68)**

Table 7.9-ADP- Age at Death profile at Buckland, Dover, Kent
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

The age at death profile at the site of Eccles is shown in Table 7.10-ADP. Of the 169 individuals, 133 were adults and 36 (21.30 percent) were juveniles (aged below 16 years). Seventy two adults (42.6 %) were males, and 61 (36.1 %) were females. Eighteen males (25.0 %) were young adults (16-25 years), 18 (25.0 %) were adults of undetermined age, 15 (20.8 %) were middle adults (26-35 years), 13 (18.1 %) were mature adults (36-45 percent), and eight (11.1 %) were old adults (45+ years).

Sixteen females (26.2 %) were young adults (16-25 years), 13 (21.3 %) were middle adults (26-35 years), 13 (21.3 %) were old adults (45+ years), 10 (16.4 %) were mature adults (36-45 years), and nine (14.8 %) were adults of undetermined age.

In total, 34 (25.6 %) individuals were young adult (16-25 years), 28 (21.1 %) were middle adult (26-35 years), 27 (20.3 %) were adults of undetermined age, 23 (17.3 %) were mature adult (36-45 years), and 21(15.8 %) were old adult (45+ years).

Eccles, Kent (Boocock *et al.*, 1995)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**36**						**36** 21.3
Females % %*		**16** 26.2 47.1	**13** 21.3 46.4	**10** 16.4 43.5	**13** 21.3 61.9	**9** 14.8 33.3	**61** 36.1
Males % %*		**18** 25.0 52.9	**15** 20.8 53.6	**13** 18.1 56.5	**8** 11.1 38.1	**18** 25.0 66.7	**72** 42.6
US % %*							
Total %**	**36**	**34** 25.6	**28** 21.1	**23** 17.3	**21** 15.8	**27** 20.3	**169** **(133)**

Table 7.10-ADP- Age at Death profile at Eccles, Kent
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, Adult= adult of undetermined age, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.
Note: There are a lot of discrepancies in the skeletal report between the text and the Tables provided.

Table 7.11-ADP shows the age at death profile at the site of Staunch Meadows, Brandon. Of the 88 adults individuals, 47 (53.4 %) were males, and 41 (46.6 %) were females. Fifteen males (31.9 %) were mature adults (36-45 years), 13 (27.7 %) were middle adults (26-35 years), 11 (23.4 %) were young adults (16-25 years), and eight (17.0 %) were old adults (45+ years). Thirteen females (31.7 %) were young adults (16-25 years), 10 (24.4 %) were middle adults (26-35 years), 10 (24.4 %) females were mature adults (36-45 years) and eight (19.5 %) were old adults (45+ years).

In total, 25 (28.4 %) individuals were mature adults (36-45 years), 24 (27.3 %) were young adults (16-25 years), 23 (26.1 %) were middle adults (26-35 years), and 16 (18.2 %) were old adult (45+ years).

Staunch Meadow, Brandon, Suffolk (Anderson, 1990)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles							
Females % %*		**13** 31.7 54.2	**10** 24.4 43.4	**10** 24.4 40.0	**8** 19.5 50.0		**41** 46.6
Males % %*		**11** 23.4 45.8	**13** 27.7 56.5	**15** 31.9 60.0	**8** 17.0 50.0		**47** 53.4
US % %*							
Total %**		**24** 27.3	**23** 26.1	**25** 28.4	**16** 18.2		**88** **(88)**

Table 7.11-ADP- Age at Death profile at Staunch Meadows, Brandon, Suffolk
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

The age at death profile at the site of Edix Hill, Barrington is shown in Table 7.12-ADP. Of the 123 individuals, 38 (30.9 %) were juveniles (aged below 16 years), and 85 were adults. Forty one (33.3 %) were males, 39 (31.7 %) were females, and five (4.1 %) were adults of unspecified sex. Fifteen males (36.6 %) were young adults (16-25 years), 15 (36.6 %) were mature adults (36-45 years), nine (22.0 %) were middle adults (26-35 years), and two (4.9 %) were old adults (45+ years). Fifteen females (38.5 %) were middle adults (26-35 years), 12 (30.8 %) were young adults (16-25 years), seven (18.0 %) were mature adults (36-45 years), and five (12.3 %) were old adults (45+ years). Five (100%) adults of unspecified sex were young adults (16-25 years). In total, 32 (37.7 %) individuals were young adults (16-25 years), 24 (28.2 %) were middle adults (26-35 years), 22 (25.9 %) were mature adults (36-45 years), and seven (8.2 %) were old adults (45+ years).

Edix Hill, Barrington, Cambridgeshire (Duhig, 1998)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**38**						**38** 30.9
Females % %*		**12** 30.8 37.5	**15** 38.5 62.5	**7** 18.0 31.8	**5** 12.3 71.4		**39** 31.7
Males % %*		**15** 36.6 46.9	**9** 22.0 37.5	**15** 36.6 68.2	**2** 4.9 28.6		**41** 33.3
US % %*		**5** 100 15.6					**5** 4.07
Total %**	**38**	**32** 37.7	**24** 28.2	**22** 25.9	**7** 8.2		**123** **(85)**

Table 7.12-ADP- Age at Death profile at Edix Hill, Barrington, Cambridgeshire
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

No detailed data was presented in the skeletal report for North Elmham Park for age at death. However, Wells and Cayton (1980:252) indicate that the combined adult mean age at death at this site was 37 years, and the juvenile mean age at death was 6.6 years. The combined adult mean age at death falls within the mature adult category (36-45 years).

Table 7.13-ADP displays the age at death profile at the site of Burgh Castle. Of the150 individuals, 120 were adults and 30 (20.0 %) were juveniles (aged below 16 years). Seventy adults (46.7 %) were males and 50 (33.3 %) were females. Twenty nine (41.4 %) males were mature adults (36-45 years), 24 (34.3 %) were old adults (45+ years), nine (12.9 %) were middle adults (26-35 years), and eight (11.43 percent) were young adults (16-25 years).

Seventeen females (34.0 %) were mature adults (36-45 years), 13 (26.0 %) were middle adults (26-35 years), 13 (26.0 %) were old adults (45+ years), and seven (14.0 %) were young adults (16-25 years). In total, 46 (38.3 %) individuals were mature adults (36-45 years), 37 (30.8 %) were old adults (45+ years), 22 (18.3 %) were middle adults (26-35 years), and 15 (12.5 %) were young adults (16-25 years).

Burgh Castle, Norfolk (Anderson and Birkett, 1991, 1993)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles	**30**						**30** 20.0
Females % %*		**7** 14.0 46.7	**13** 26.0 59.1	**17** 34.0 37.0	**13** 26.0 35.1		**50** 33.3
Males % %*		**8** 11.4 53.3	**9** 12.9 40.9	**29** 41.4 63.0	**24** 34.3 64.9		**70** 46.7
US % %*							
Total %**	**30**	**15** 12.5	**22** 18.3	**46** 38.3	**37** 30.8		**150** **(120)**

Table 7.13-ADP- Age at Death profile at Burgh Castle, Norfolk
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

Summary of Early Medieval age at death data

Table 7.14-ADP and Figure 7.3-ADP display the age at death profiles for the sites considered for the Early Medieval period. Of the 953 individuals, 373 individuals (39.1 %) were females, 343 (36.0 %) were males, 151 (15.8 %) were juveniles, and 86 (9.0 %) were adults of undetermined sex. For females, 112 (30.0 %) were middle adults (26-35 years), 94 (25.2 %) were young adults (16-25 years), 93 (24.9 %) were mature adults (36-45 years), 65 (17.4 %) were old adults (45 + years), and nine (2.4 %) were adults of undetermined age.

For the males, 104 (30.3 %) were mature adults (36-45 years), 88 (25.7 %) were middle adults (26-35 years), 68 (19.8 %) were young adults (16-25 years), 65 (18.6 %) were old adults (45 +), and 18 (5.3 %) were adults of undetermined age. For adults of undetermined sex, 30 (34.9 %) were middle adults (26-35 years), 29 (33.7 %) were old adults (45 +), 15 (17.4 %) were young adults (16-25 years), and 12 (14.0 %) were mature adults (36-45 years).

In total during the Early Medieval period, 230 individuals (28.7 %) were middle adults (26-35 years), 209 (26.1 %) were mature adults (36-45 years), 177 (22.1 %) were young adults (16-25 years), 159 (19.8 %) were old adults (45 + years), and 27 (3.4 %) were adults of undetermined age. Figure 7.4-ADP shows age at death during the Early Medieval period.

	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**151**						**151** 15.8
Females % %*		**94** 25.2 53.1	**112** 30.0 48.7	**93** 24.9 44.5	**65** 17.4 40.9	**9** 2.4 33.3	**373** 39.1
Males % %*		**68** 19.8 38.4	**88** 25.7 38.3	**104** 30.3 49.8	**65** 18.6 40.9	**18** 5.3 66.7	**343** 36.0
US % %*		**15** 17.4 8.5	**30** 34.9 13.0	**12** 14.0 5.7	**29** 33.7 18.2		**86** 9.0
Total %**	**151**	**177** 22.1	**230** 28.7	**209** 26.1	**159** 19.8	**27** 3.4	**953** **(802)**

Table 7.14-ADP- Age at Death profile for Early Medieval Sites
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

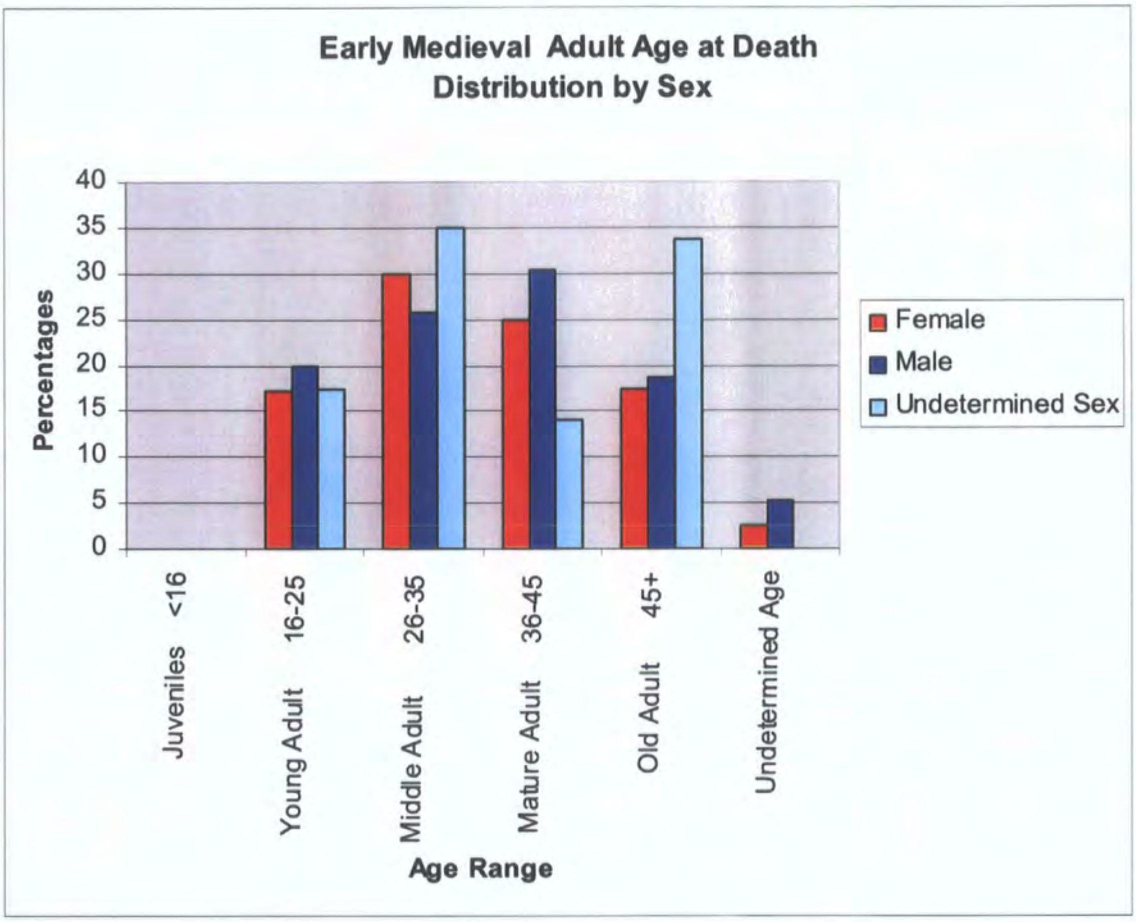


Figure 7.3-ADP- Age at Death profile for the Early Medieval period, distributed by sex.

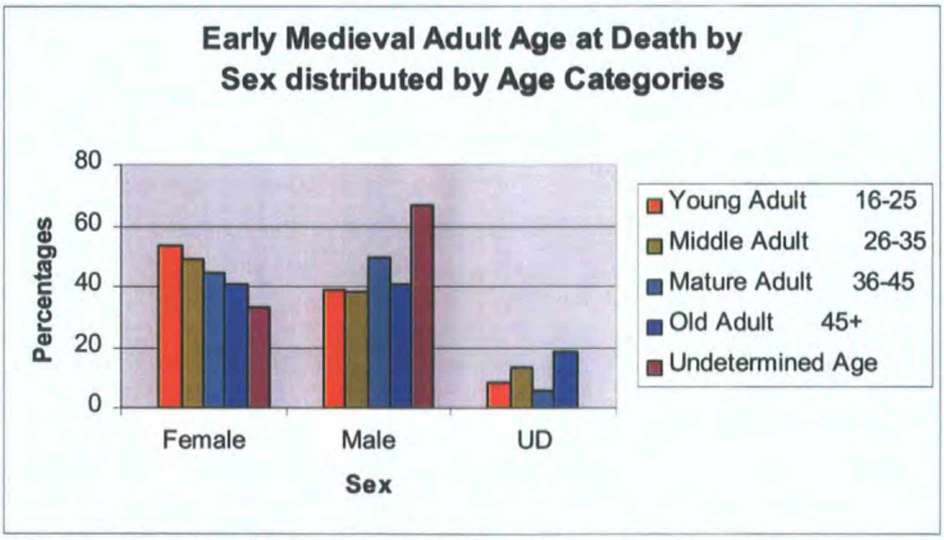


Figure 7.4-ADP- Age at Death profile for the Early Medieval period, by age categories

7.7.3 Late Medieval Age at Death Profile

Table 7.15-ADP shows the age at death profile at the site of Blackfriars Friary, Ipswich. Of the 250 individuals, 24 (9.6 %) were juveniles (aged below 16 years) and 226 were adults, of which 148 (59.2 %) were males and 64 (25.6 %) were females. For the males, 41 (27.7 %) were mature adults (36-45 years), 40 (27.0 %) were old adults (45+ years), 27 (18.2 %) were middle adults (26-35 years), 20 (13.5 %) were young adults (16-25 years), and 20 (13.5 %) were adults of undetermined age.

For the females, 19 (29.7 %) were old adults (45+ Years), 13 (20.3 %) were middle adults (26-35 years), 13 (20.3 %) were mature adults (36-45 years), 10 (15.6 %) were adult of undetermined age, and nine (14.1 %) were young adults (16-25 years). In total, 60 (26.6 %) individuals were old adults (45+ years), 56 (24.8 %) were mature adults (36-45 years), 41 (18.1 %) were middle adults (26-35 years), 40 (17.7 %) were adults of undetermined age, and 29 (12.8 %) were young adults (16-25 years).

Blackfriars Friary, Ipswich, Suffolk (Mays, 1991)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**24**						**24** 9.6
Females % %*		**9** 14.1 31.0	**13** 20.3 31.7	**13** 20.3 23.2	**19** 29.7 31.7	**10** 15.6 25.0	**64** 25.6
Males % %*		**20** 13.5 69.0	**27** 18.2 4.9	**41** 27.7 73.2	**40** 27.0 66.7	**20** 13.5 50.0	**148** 59.2
US % %*			**1** 7.1 2.4	**2** 14.3 3.6	**1** 7.1 1.7	**10** 71.4 25.0	**14** 5.6
Total %**	**24**	**29** 12.8	**41** 18.1	**56** 24.8	**60** 26.6	**40** 17.7	**250** **(226)**

Table 7.15-ADP- Age at Death profile at Blackfriars Friary, Ipswich, Suffolk
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

No age at death data was presented in the skeletal reports (Lee and Magilton, 1989; Magilton and Lee, 1989) for the Late Medieval site of St James and St Mary Magdalene Hospital, Chichester.

Table 7.16-ADP shows the age at death profile at the site of Royal Mint, St Mary Graces Priory. Of the 841 individuals, 685 were adults of unspecified sex and 156 (18.6 %) were juveniles (aged below 16 years). For adults of unspecified sex, 239 (34.9 %) were adults of undetermined age, 127 (18.5 %) were middle adults (26-35 years), 127 (18.5 %) were old adults (45+ years), 110 (16.1 %) were mature adults (36-45 years), and 82 (12.0 %) were young adults (16-25 years).

Royal Mint, St Mary Graces Priory, London (Waldron, 1993)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles	**156**						**156** 18.6
Females % %*							
Males % %*							
US % %*		**82** 12.0 100	**127** 18.5 100	**110** 16.1 100	**127** 18.5 100	**239** 34.9 100	**685** 81.5
Total %**		**82** 12.0	**127** 18.5	**110** 16.1	**127** 18.5	**239** 34.9	**841** **(685)**

Table 7.16-ADP- Age at Death profile at Royal Mint, St Mary Graces Priory, London
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

Table 7.17-ADP shows the age at death profile at the site of St. Nicholas Shambles. Of the 234 individuals, 188 were adults and 46 (19.7 %) were juveniles (aged below 16 years).

Ninety individuals (38.5 %) were males, 77 (32.9 %) were females and 21 (9.0 %) were adults of unspecified sex. For the males, 22 (24.4 %) were middle adults (26-35 years), 22 (24.4 %) were classified as adults of undetermined age, 20 (22.2 %) were young adults (16-25 years), 17 (18.9 %) were mature adults (36-45 years), and nine (10.0 %) were old adults (45+ years).

For the females, 25 (32.5 %) were middle adults (26-35 years), 21 (27.3 %) were mature adults (36-45 years), 15 (19.5 %) females were adults of undetermined age, 10 (13.0 %) were young adults (16-25 years), and six (7.8 %) were old adults (45+ years). Of the 21 adults of unspecified sex, 18 (85.7 %) were adults of undetermined age, one (4.8 %) was a young adult (16-25 percent), one (4.8 %) was a middle adult (26-35 years), and one (4.8 %) was a mature adult (36-45 years).

In total, 55 (29.3 %) individuals were adults of undetermined age, 48 (25.5 %) were middle adults (26-35 percent), 39 (20.7 %) were mature adults (36-45 years), 31 (16.5 %) were young adults (16-25 years), and 15 (8.0 %) were old adults (45+ years).

St Nicholas Shambles, London (White, 1988)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**46**						**46** 19.7
Females % %*		**10** 13.0 32.3	**25** 32.5 52.1	**21** 27.3 53.9	**6** 7.8 40.0	**15** 19.5 27.3	**77** 32.9
Males % %*		**20** 22.2 64.5	**22** 24.4 41.7	**17** 18.9 43.6	**9** 10.0 60.0	**22** 24.4 40.0	**90** 38.5
US % %*		**1** 4.8 3.2	**1** 4.8 2.1	**1** 4.8 2.6		**18** 85.7 32.7	**21** 9.0
Total %**	**46**	**31** 16.5	**48** 25.5	**39** 20.7	**15** 8.0	**55** 29.3	**234** **(188)**

Table 7.17-ADP- Age at Death profile at St. Nicholas Shambles, London
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

The age at death profile at the site of Spitalfields Market can be seen in Table 7.18-ADP. Of the 200 individuals, 168 were adults and 32 (16.0 %) were juveniles (aged below 16 years). Eighty three adults (41.5 %) were males, 76(38.0 %) were females and nine (4.5 %) were adults of unspecified sex. For males, 28 (33.7 %) were young adults (16-25 years), 23 (27.7 %) were middle adults (26-35 years), 15 (18.1 %) were mature adults (36-45 years), 15 (18.1 %) were old adults (45 + years), and two (2.4 %) were adults of undetermined age.

For females, 23 (30.3 %) were middle adults (26-35 years), 21 (27.6 %) females were old adults (45+ years), 16 (21.1 %) were young adults (16-25 years), 12 (15.8 %) were mature adults (36-45 years), and four (5.3 %) were adult of undetermined age. For adults of unspecified sex, four (44.4 %) were adults of undetermined age, three (33.3 %) were young adults (16-25 years), and two (22.2 %) were middle adults (26-35 years).

In total, 48 (28.6 %) individuals were middle adults (26-35 years), 47 (28.0 %) were young adults (16-25 years), 36 (21.4 %) were old adults (45+ years), 27 (16.1 %) were mature adults (36-45 years), and 10 (6.0 %) were adults of undetermined age.

Spitalfields Market, London (Connell, 2002; Conheeney, 1997)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**32**						**32** 16.0
Females % %*		**16** 21.1 34.0	**23** 30.3 47.9	**12** 15.8 44.4	**21** 27.6 58.3	**4** 5.3 40.0	**76** 38.0
Males % %*		**28** 33.7 59.6	**23** 27.7 47.9	**15** 18.1 55.6	**15** 18.1 41.7	**2** 2.4 20.0	**83** 41.5
US % %*		**3** 33.3 6.4	**2** 22.2 4.2			**4** 44.4 40.0	**9** 4.5
Total %**	**32**	**47** 28.0	**48** 28.6	**27** 16.1	**36** 21.4	**10** 6.0	**200** **(168)**

Table 7.18-ADP- Age at Death profile at Spitalfields Market, London
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

Table 7.19-ADP shows the age at death profile at the site of Thetford. Of the 77 individuals, 36 were adults and 41 (53.3 %) were juveniles (aged below 16 years). Eighteen adults (23.4 %) were males and 18 (23.4 percent) were females. For males, nine (50.0 %) were mature adults (36-45 years), four (22.2 %) were old adults (45+ years), three (16, 7 %) were middle adults (26-35 years) and two (11.1 %) were young adults (16-25 years).

For females, six (33.3 %) were mature adults (36-45 percent), five (27.8 %) were old adults (45 + years), five (27.8 %) were middle adults (26-35 years), and two (11.1 %) were young adults (16-25 years). In total, 15 (41.7 %) individuals were mature adults (36-45 years), nine (25.0 %) were old adults (45+ years), eight (22.0 %) were middle adults (26-35 years), and four (11.1 %) were young adults (16-25 years).

Thetford, Norfolk (Stroud, 1993)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**41**						**41** 53.3
Females % %*		**2** 11.1 50.0	**5** 27.8 62.5	**6** 33.3 40.0	**5** 27.8 55.6		**18** 23.4
Males % %*		**2** 11.1 50.0	**3** 16.7 37.5	**9** 50.0 60.0	**4** 22.2 44.4		**18** 23.4
US % %*							
Total %**	**41**	**4** 11.1	**8** 22.0	**15** 41.7	**9** 25.0		**77** **(36)**

Table 7.19-ADP- Age at Death profile at Thetford, Norfolk
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

Table 7.20-ADP shows the age at death profile at the site of Stratford Langthorne Abbey. Of the 505 individuals, 496 were adults and nine (1.8 %) were juveniles (aged below 16 years). There were 472 (93.5 %) males and 24 (4.8 %) were females. For males, 244 (51.7 %) were middle adults (26-35 years), 132 (28.0 %) were old adults (45+ years), and 96 (20.3 %) were young adults (16-25 years).

For females, 11 (45.8 %) were old adults (45+ years), nine (37.5 %) were middle adults (26-35 years), and four (16.7 %) were young adults (16-25 years). In total, 253 (51.0 %) individuals were middle adults (26-45 years), 143 (28.8 %) were old adults (45 + years), and 100 (20.2 %) were young adults (16-25 years).

Stratford Langthorne Abbey, Essex (White, 1999; Stuart-Macadam, 1985b, 1986)							
	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**9**						**9** 1.8
Females % %*		**4** 16.7 4.0	**9** 37.5 3.6		**11** 45.8 7.7		**24** 4.8
Males % %*		**96** 20.3 96.0	**244** 51.7 96.4		**132** 28.0 92.3		**472** 93.5
US % %*							
Total %**	**9**	**100** 20.2	**253** 51.0		**143** 28.8		**505** **(496)**

Table 7.20-ADP- Age at Death profile at Stratford Langthorne Abbey, Essex (% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, U= adults of undetermined sex, US= adults of unspecified sex in the report, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

Summary of Late Medieval age at death data

Table 7.21-ADP and Figure 7.5-ADP shows the age at death profile for the sites considered for the Late Medieval period. Of the 2107 individuals, 1799 were adults and 308 (14.6 %) were juveniles (aged below 16 years). Eight hundred and eleven adults (38.5 %) were males, 729 (34.6 %) were adults of unspecified sex, and 259 (12.3 %) adults were females. For males, 319 (39.3 %) were middle adults (26-35 years), 200 (24.7 %) were old adults (45+ years), 166 (20.5 %) were young adults (16-25 years), 82 (10.1 %) were mature adults (36-45 years), and 44 (5.4 %) were adults of undetermined age.

For females, 75 (29.0 percent) were middle adults (26-35 years), 63 (24.3 %) were mature adults (36-45 years), 51 (19.7 %) were old adults (45+ years), 41 (15.8 %) were young adults (16-25 years), and 29 (11.2 %) were adults of undetermined age. For the 729 adults of unspecified sex, 271 (37.2 %) were adults of undetermined age, 131 (18.0 %) were middle adults (26-35 years), 128 (17.6 %) were old adults (45+ years), 113 (15.5 %) were mature adults (36-45 years), and 86 (11.8 %) were young adults (16-25 years).

In total during the Late Medieval period, 525 (29.2 %) individuals were middle adults (26-35 years), 379 (21.1 %) were old adults (45+ years), 344 (19.1 %) were adults of undetermined age, 293 (16.3 %) were young adults (16-25 years), and 258 (14.3 %) were mature adults (36-45 years). Figure 7.6-ADP shows age at death during the Late Medieval period.

	Juveniles <16	Young Adult 16-25	Middle Adult 26-35	Mature Adult 36-45	Old Adult 45+	UA	Total
Juveniles %*	**308**						**308** 14.6
Females % %*		**41** 15.8 14.0	**75** 29.0 14.3	**63** 24.3 24.4	**51** 19.7 13.5	**29** 11.2 8.4	**259** 12.3
Males % %*		**166** 20.5 56.7	**319** 39.3 60.8	**82** 10.1 31.8	**200** 24.7 52.8	**44** 5.4 12.8	**811** 38.5
US % %*		**86** 11.8 29.4	**131** 18.0 25.0	**113** 15.5 43.8	**128** 17.6 33.8	**271** 37.2 78.8	**729** 34.6
Total %**	**308**	**293** 16.3	**525** 29.2	**258** 14.3	**379** 21.1	**344** 19.1	**2107** **(1799)**

Table 7.21-ADP- Age at Death profile for Late Medieval Sites
(% = percentage within row, %* = percentage within column, %** = percentage within age class in relation to all adults, US= adults of unspecified sex in the report, UA= Adult of undetermined age, () = number of adult individuals).
Note: Blank cells imply that information was not provided by the skeletal report.

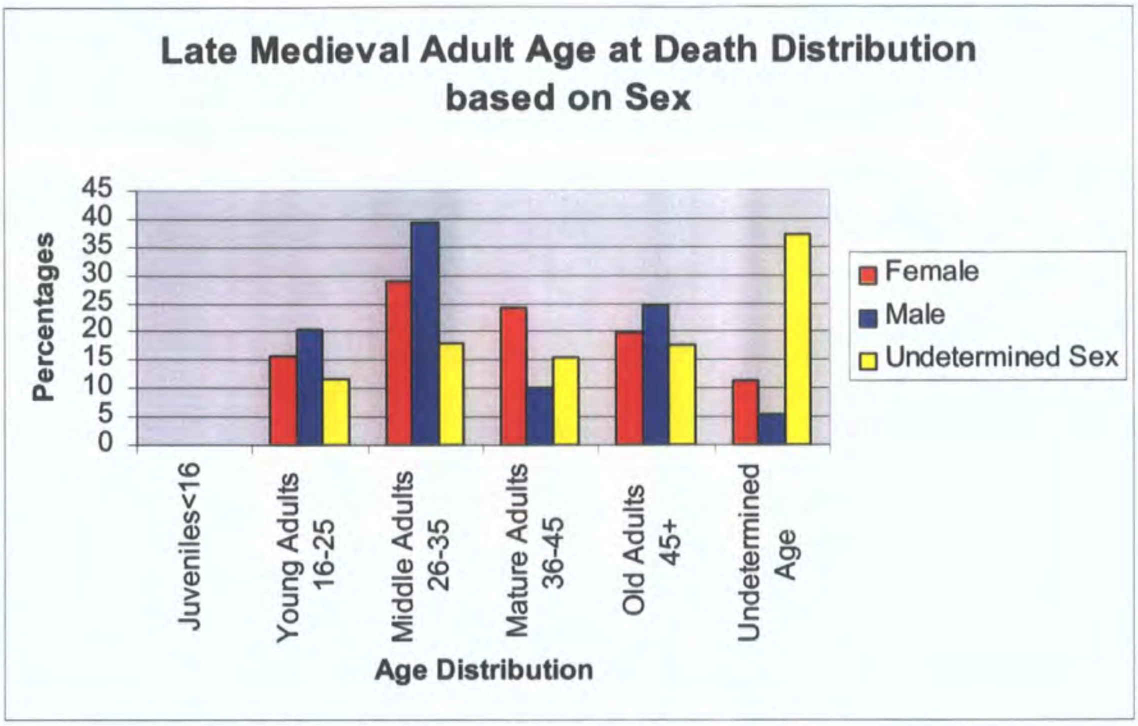


Figure 7.5-ADP- Age at Death profile for Late Medieval period, distributed by sex

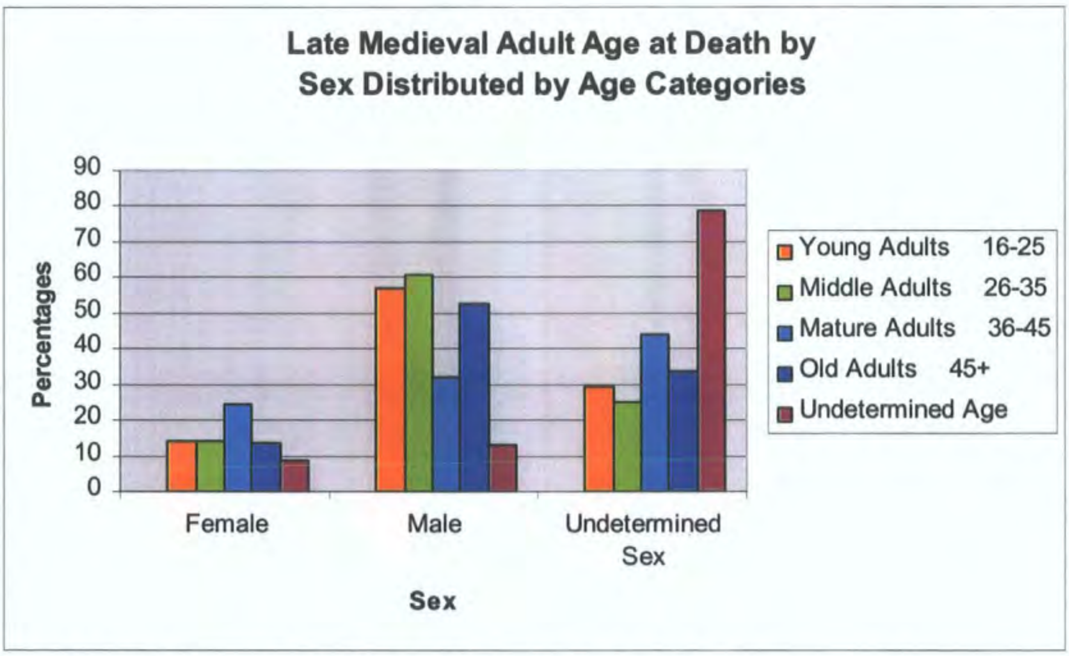


Figure 7.6-ADP- Age at Death profile Late Medieval period, distributed by age categories

7.7.4 Age at death Profile: All periods

Table 7.22-ADP and Figure 7.7-ADP present the percentage of deaths in each adult age group by period. During the Romano-British period, 34.1 % of individuals were middle

adults (26-35 years), 26.2 % were mature adults (36-45 years), 16.1 % were young adults (16-25 years), 6.5 % were old adults (45 +), and 17.2 % were adults of undetermined age.

	Juveniles <16	Young Adults 16-25	Middle Adults 26-35	Mature Adults 36-45	Old Adults 45+	Adults Undetermined Age
Romano-British		16.1	34.1	26.2	6.5	17.2
Early medieval		22.1	28.7	26.1	19.8	3.4
Late Medieval		16.3	29.2	14.3	21.1	19.1

Table 7.22-ADP- Age at death profile by period (%).

During the Early Medieval period, 28.7 % of individuals were middle adults (26-35 years), 26.1 % were mature adults (36-45 years), 22.1 % were young adults (16-25 years), 19.8 % were old adults (45 + years), and 3.4 % were adults of undetermined age. During the Late Medieval period, 29.2 % of individuals were middle adults (26-35 years), 21.1 % were old adults (45 + years), 16.3 % were young adults (16-25 years), 14.3 % were mature adults (36-45 years), and 19.1 % were adults of undetermined age.

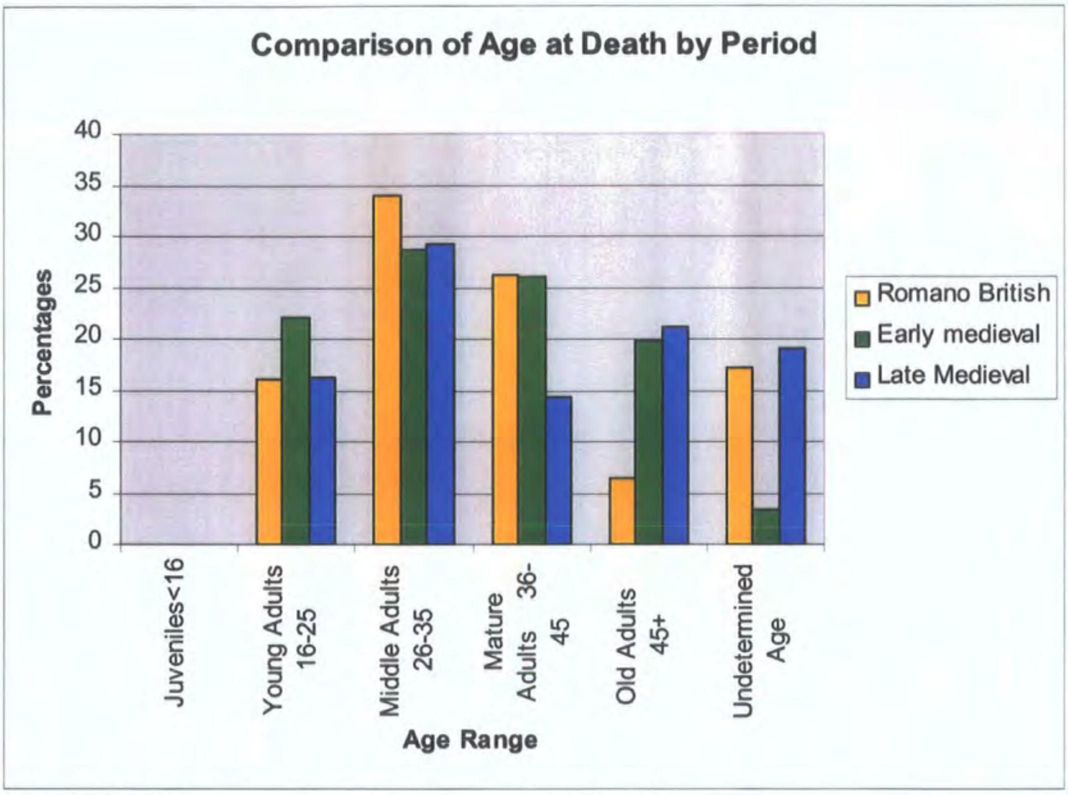


Figure 7.7-ADP- Age at Death profile comparison for all periods.

Figures 7.8-ADP, 7.9-ADP, and 7.10-ADP show the age at death profiles for males, females and adults of undetermined sex by period.

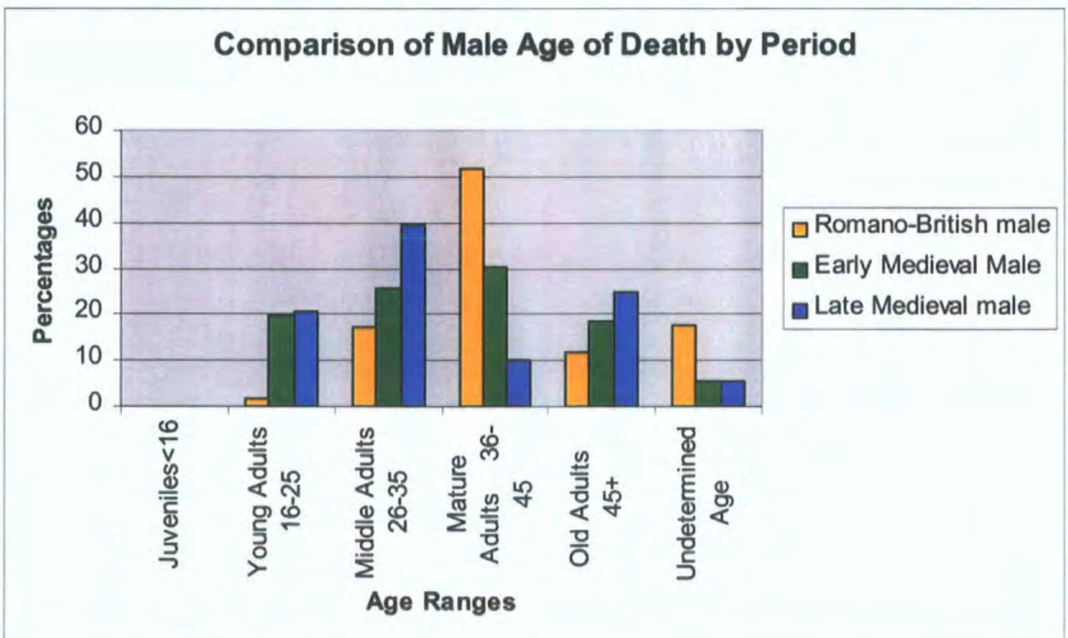


Figure 7.8-ADP- Male Age at Death profile by period

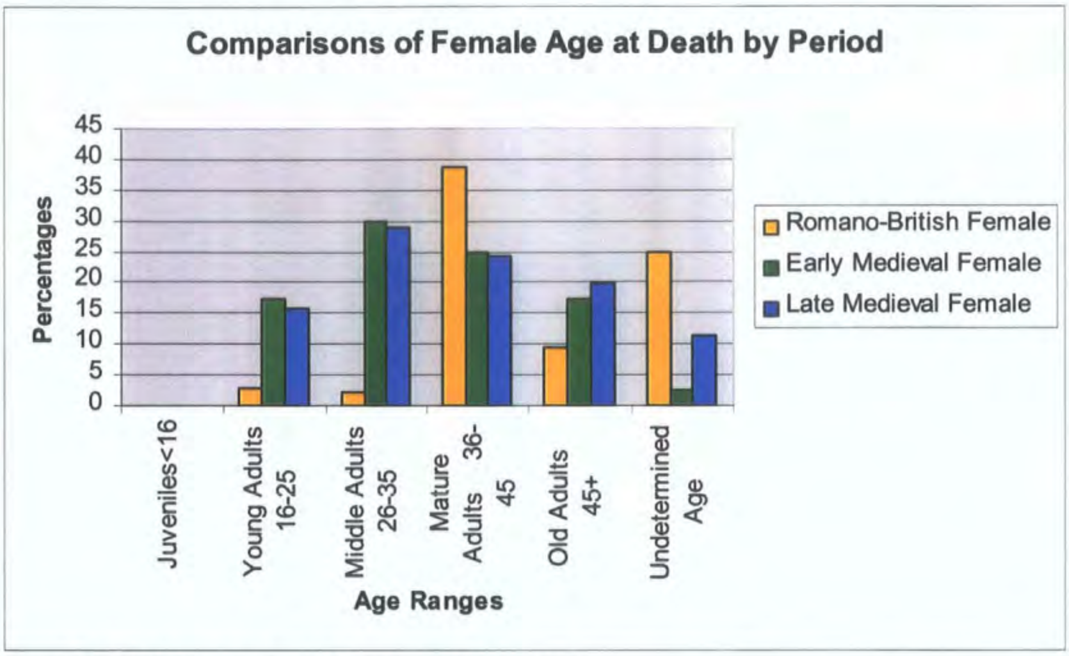


Figure 7.9-ADP- Female Age at Death profile by period

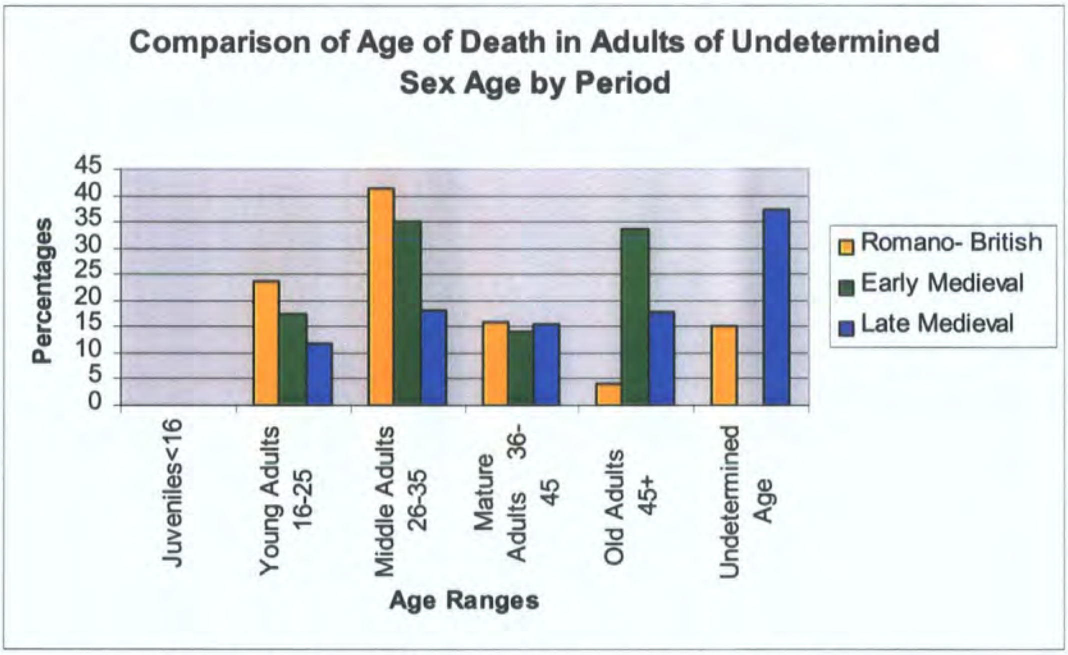


Figure 7.10- ADP Age at Death Profile for Adults of undetermined sex by period.

Table 7.23-ADP, and Figures 7.11-ADP, 7.12-ADP, give the mean age at death profile comparison for all periods by sex. It is understood that it is very difficult to be precise with these data as the methods for ageing skeletal remains are inaccurate (see section 6.3.3), and

the information has been pooled from various skeletal reports, and many different bioarchaeologists produced the reports. However, as the mean age at death is provided by the reports, it has been used here to see if any relationship exists between the mean age at death provided and the general health of the population from the different periods. This information could give a basic idea of the age composition of the population. Nevertheless, caution is recommended with these data.

Female mean age at death was highest during the Romano-British period (36.6 years), followed by the Late Medieval period (34.9 years), and lowest during the Early Medieval period (30.7 years). Male mean age at death was highest during the Romano-British period (38.2 years), followed by the Early Medieval period (34.1 years), and was lowest during the Late Medieval period (32.8 years).

The mean age at death for adults of undetermined sex was highest during the Late Medieval period (34.8 years), closely followed by the Early Medieval period (34.7 years), and was lowest during the Romano-British period (29.8 years). The combined adult mean age at death shows that during the Late Medieval period it was 33.7 years, followed by the Early Medieval period (32.6 years), and the Romano-British period (32.4 years). Differences in age at death between the Romano-British and the Early Medieval periods were found to be statistically significant (X^2= 193.23, $P<0.001$, d.f=5) and statistically significant between the Early Medieval period and the Late Medieval periods (X^2= 149.64, $P<0.001$, d.f=5).

	Romano-British	Early Medieval	Late Medieval
Female	36.6	30.7	34.9
Male	38.2	34.1	32.8
Adults Undetermined Sex	29.8	34.7	34.8
Combined Adult	32.4	32.6	33.7

Table 7.23-ADP- Mean Age at Death profile comparison for all periods by sex.

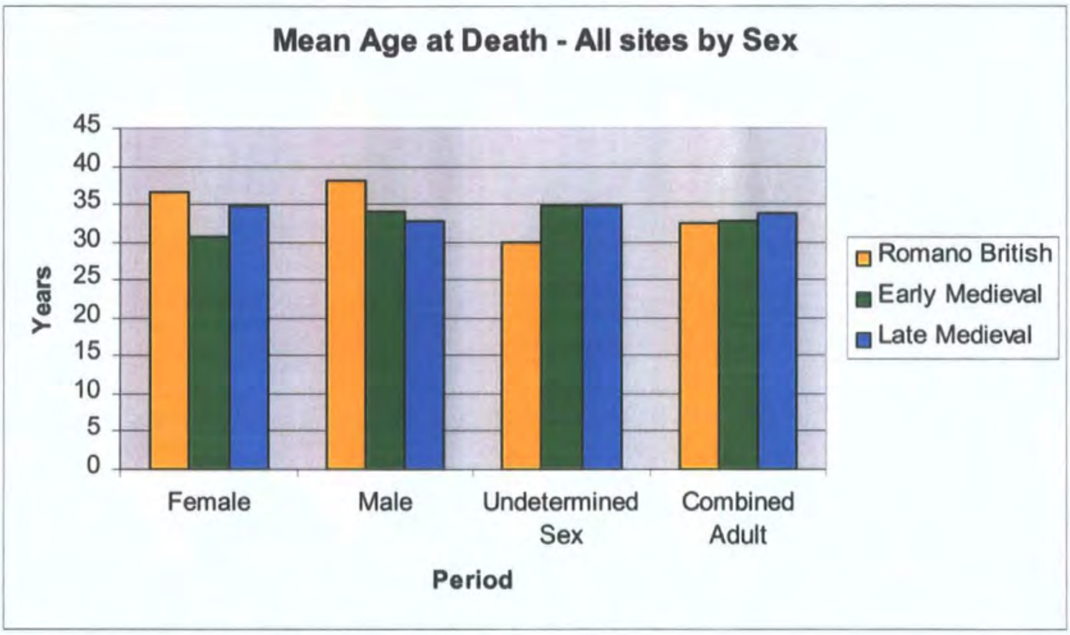


Figure 7.11-ADP- Mean age at death- All sites compared by sex.

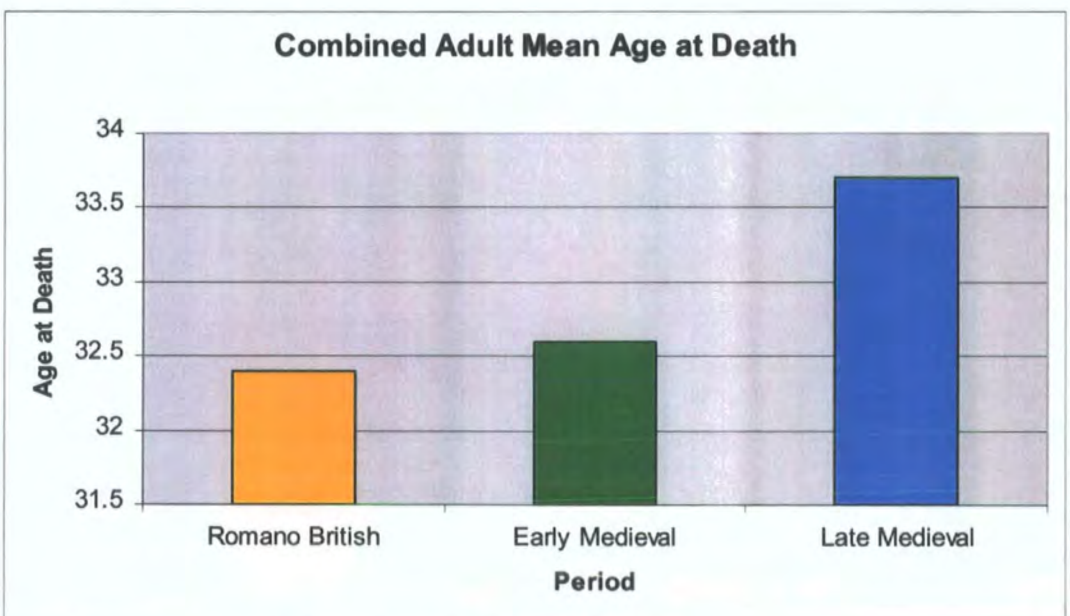


Figure 7.12- ADP- Combined adult mean age at death.

7.8 Summary of Data

- Dental caries frequency was lowest in the Early Medieval period. Distribution by individuals and teeth affected was significantly different between the Romano-British and the Early Medieval periods and between the Early Medieval and Late Medieval periods. Differences in dental caries prevalence by individuals and teeth affected between the three periods were found to be statistically significant.
- Enamel Hypoplasia was lowest in the Romano-British period. Distribution by individuals affected was significantly different between the Romano-British and the Early Medieval periods but not statistically significant between the Early Medieval and Late Medieval periods but, the differences in enamel hypoplasia prevalence between the three periods were found to be statistically significant. The enamel hypoplasia distribution by teeth affected was significantly different between the Romano-British and the Early Medieval periods and between the Early Medieval and Late Medieval. Differences in enamel hypoplasia prevalence by teeth affected between the three periods were also found to be statistically significant.
- The stature was highest for the Early Medieval period. Statistical analysis shows that there was a statistically significant increase in height during the Early Medieval period from the Romano-British period and the stature decreased from the Early Medieval to the Late Medieval period. This was found for both males and females and the stature compares to the height of modern English people.
- Cribra orbitalia frequency was lowest in the Early Medieval period. Distribution by individuals affected was not significantly different between the Romano-British and the Early Medieval periods but was statistically significant between the Early Medieval and the Late Medieval periods. Differences in cribra orbitalia prevalence

by individuals affected between the three periods were found to be statistically significant.

- Tibial periostitis was lowest in the Early Medieval period. Distribution by individual affected was not significantly different between the Romano-British and the Early Medieval periods but statistically significant between the Early Medieval and the Late Medieval periods. Differences in tibial periostitis prevalence by individuals affected between the three periods were found to be statistically significant
- The distribution of ages for all periods shows a statistically significant difference between them.

Chapter 8: Discussion

8.1 Introduction

In this chapter the evaluation and interpretation results are presented, and the cultural contextual data for each period are integrated with data on stress markers to understand the patterns seen. It has been noted that many variables relating to a population's socio-cultural, economic and political status have a noticeable influence on their health, for example, the type of occupation a person practices, diet, the climate and environment in where they live, life experience of war, lower socio-economic status and even positive stimuli (Goodman *et al.*, 1988; Cohen, *et al.*, 1993; Garrow and James, 1993; Litt *et al.*, 1995; Brothwell and Brothwell, 1998; Bush, 1991; Smith *et al.*, 2000; Crews, 2007). These factors can produce certain levels of "stress" that could promote changes on the body and ultimately the skeleton. Furthermore, health status influences factors such as life expectancy, reproductive potential and the capacity for work and learning (Eller *et al.,* 2006; Crews, 2007), all of which are crucial to the maintenance of a society, past and present. It should be noted that, for many of the sites studied, very little contextual data was available. Therefore, general information on socio-cultural, economic and political factors for each period are, by necessity, the data used rather than site specific data.

8.2 Dental and Skeletal Markers of stress

8.2.1 Dental Caries

Results show that the prevalence of dental caries by individual and teeth affected decreased from the Romano-British (26.4% of individuals, 7.4% of teeth) to the Early Medieval period (15.4% of individuals, 3.1% of teeth) and then increased again during the Late Medieval period (35.5 % of individuals, 9.0 % of teeth). These data were found to be similar (Table 8.1) to that obtained by other studies, for example Roberts and Cox (2003: 131) study shows that during the Romano- British period 11.3 % of individuals had dental caries and 7.5% of teeth were affected. They suggest that these data show that people were not taking care of their teeth; they were consuming high quantities of carbohydrates, especially sucrose through *sapa*, wine, foods and other drinks. On the other hand, during the Early Medieval period 5.2 % of individuals and 4.2 % of teeth had dental caries (Roberts and Cox, 2003: 189) and during the Late Medieval period the prevalence was 53% for individuals affected and 5.6 % for teeth affected (Roberts and Cox, 2003:259).

	Alvaro Arce Research (2007)		Roberts and Cox (2003)	
	Individuals Affected (%)	Teeth Affected (%)	Individuals Affected (%)	Teeth Affected (%)
Romano-British	26.4	7.4	11.3	7.5
Early Medieval	15.4	3.1	5.2	4.2
Late Medieval	35.5	9.0	53	5.6

Table 8.1 Comparison of Dental Caries Results from Alvaro Arce Research and Roberts and Cox (2003).

Why the change during the Early Medieval period? The link between dental disease and diet has been noted. To avoid dental caries, a diet low in carbohydrates (sucrose) is recommended (Moynihan, 2002). During the Early Medieval period, honey was the only sweetening agent available and fruits provided fructose (Brothwell and Brothwell, 1998). Bacteria on the teeth and plaque ferment sugars (sucrose) in the mouth, this fermentation produce acids that demineralise the teeth and lead to dental caries (Pindborg, 1970; Burt *et al.*, 1988; Litt *et al.*, 1995; Hillson, 1996; Lingstrom *et al.*, 2000). It is likely that the lack of sugar in the diet contributed to the decline of dental caries during the Early Medieval period (Hillson, 1986; Duhig, 1998; Roberts and Cox, 2003), which is "an exception to the trend of increase in caries from the Neolithic to recent times (Hillson, 1986:296).

Lukacs (1989) notes that there is a relationship between agriculture and dental caries as agriculture is characterised by relatively sweet foods with a soft and sticky texture allowing food particles to stick to the teeth and promote the development of dental caries. McKinley (1993:12) and Roberts (1984:8) indicate that the high level of dental caries at the Romano-British site of Baldock 1 and Baldock 3 possibly indicates poor dental hygiene and a diet high in carbohydrates. Individuals at Baldock 1 were found to have between one to nine carious teeth (McKinley, 1993). This research have found that during the Romano-British period the highest prevalence of individuals affected by caries is found at the site of the Eastern Cemetery of Roman London (32.8%), and the site of Baldock 1 had the highest prevalence of teeth affected by caries (10.6%). Agriculture was expanded during the Romano-British period (Moore and Corbett, 1973, Jones, 1991) and cereals were the basis of the diet for the military and civilians. Farmers produced these cereals for the army, the locals and for continental trade (Grant, 1989; Jones, 1991; Bennett, 2001). Poor dental care during the Romano-British period could also have contributed to the high levels of dental caries (Conheeney, 2000a, 2000b; Jackson, 2002).

A diet low in carbohydrates is then associated with a low caries rate. During the Early Medieval period economy was based on agriculture, including fresh fruit and animal products such as meat (beef, goat, lamb, pork, fowl and wild meat such as rabbit, fowl, deer plus fish and shellfish) (Ayers, 2000). An increase in population initiated the expansion of cultivation of crops, but it also expanded areas for pastures for increasing livestock (Drewett et al., 1988; Hagen, 2006). Importantly, the consumption of meat and especially fish seems to have increased during this period which contributed to the prevention of dental caries (Roberts and Cox, 2003; Hagen, 2006). Grant (1989) and Hagen (2006) note that the intake of pork, which had declined during the Romano-

British period, increased during the Early Medieval period, and Brothwell and Brothwell (1998) explain that the herring industry was also established at this time. Both rich and poor ate meat, domesticated and wild (Hagen, 1995; 2006). Certainly, this illustrates that a great quantity of meat was eaten, providing enough iron, protein and zinc, but the diet did not have sufficient carbohydrates to produce a high rate of caries. Daily food during the Early Medieval period was basically baked bread, flour, cheese, milk, water, eggs, porridge and fresh fruits (Hagen, 1992, 1995, 2006). Moynihan (2002) suggests that bread, water, fresh fruit, cheese and milk are foods with a low dental caries risk, possessing anti-cariogenic effects. It is possible that the consumption of these daily foods contributed to the decline of dental caries during this period.

Another possible reason for the declined of dental caries during the Early Medieval period could be associated with the strong familial and kin-based relationships characteristic of this period (Charles-Edwards, 1989; Hollis, 1992; Williams, 1996; Dyer, 2000). As previously mentioned societies with strong relationships would support each other in every aspect of life (Light *et al*, 2004; Perlman, 2007). It is possible that in this period dental health care and hygiene was encouraged and supported by family and friends. Settlement patterns, burial practices and evidence for agriculture and pastures supports the idea that Early Medieval society had close bonds, and social comradeship relations that provided security between each other (Drewett et al., 1988; Charles-Edwards, 1989; Hollis, 1992; Williams, 1996; Dyer, 2000; Hagen, 2006).

Moore and Corbett (1971:151 and 1973) and Roberts and Manchester (1997: 53) suggest that attrition could be beneficial to the teeth as it removes pits and fissures on the tooth's biting (occlusal) surfaces and this prevents the accumulation of food particles in these areas, thus preventing dental caries. This could also have contributed to the low rate of dental caries during the Early Medieval period. This statement, however, needs to be taken with caution as the already weakened structure of a tooth because of attrition would have more chances of developing dental caries than a healthy tooth without wear. In addition, Millard and Gowland (2002) concluded that late Romano-British and Early Medieval wear rates were indistinguishable.

During the Late Medieval period diet was more varied which reflects the expansion of trade, land and the increase in population (Dyer, 2000). Agriculture increased enormously which introduced greater amounts of carbohydrates to the diet; cereals were the main foods (wheat, barley, oats and rye) (Hammond, 1993) produced in many geographical locations; including gardens and high altitude areas (Taylor, 1988; Dyer, 2000). Furthermore, the expansion of markets and trade brought in cane sugar and sugar beet (sucrose). In combination with honey, wild and dried fruits provided large amounts of sucrose. Sugar, as explained before, is the main foodstuff associated with the onset of dental caries and therefore it is possible to give another reason for the rise in dental caries during the Late Medieval period (Pindborg, 1970; Burt *et al.*, 1988; Litt *et al.*, 1995; Hillson, 1996; Lingstrom *et al.*, 2000; Moynihan, 2002, 2003). As an illustration of the high prevalence of dental caries during the Late Medieval period, the sites of St. James and St. Mary Magdalene Hospital, Chichester (52.3%) and Spitalfields Market, London (47.5%) provided the highest prevalence of dental caries of all the sites considered from all periods.

8.2.2 Enamel Hypoplasia

Results showed that the prevalence of enamel hypoplasia by individual and teeth affected increased through time from the Romano-British period (21.0 % of individuals, 8.5% of teeth) to the Early Medieval period (23.2 % of individuals, 9.6% of teeth) and during the Late Medieval period (32.4 % of individuals 24.0 % of teeth). The distribution of individuals affected compares (Table 8.2) with that found by Roberts and Cox (2003), but, the distribution for teeth affected differs. Roberts and Cox (2003) show the prevalence of teeth affected by enamel hypoplasia decreased from the Romano-British period to the Early Medieval period, while the data here show that it increased from 8.5 % to 9.6%. As the prevalence of individuals suffering from enamel hypoplasia increased between these two periods and the next, the number of teeth affected also increased. Roberts and Cox (2003:140) found that, during the Romano-British period, 6.7 % of individuals were affected by enamel hypoplasia and that 9.1 % of teeth were affected. It was suggested that these results may represent a deficient diet but that it could also represent episodes of disease. The results for the Early Medieval period were 8.9 % of individuals and 7.4% of teeth affected by enamel hypoplasia, possibly associated with infection (Roberts and Cox, 2003:185). For the Late Medieval period the rate of enamel hypoplasia was 35 % of individuals (Roberts and Cox, 2003: 264) but unfortunately no data is presented in Roberts and Cox (2003) for the number of teeth affected.

	Alvaro Arce Research (2007)		Roberts and Cox (2003)	
	Individuals Affected (%)	Teeth Affected (%)	Individuals Affected (%)	Teeth Affected (%)
Romano-British	21	8.5	6.7	9.1
Early Medieval	23.2	9.6	8.9	7.4
Late Medieval	32.4	24.0	35	

Table 8.2 Comparison of Enamel Hypoplasia Results from Alvaro Arce Research and Roberts and Cox (2003)

Taking the data obtained in this research, why did the prevalence of enamel hypoplasia by individual and teeth affected increase through time? It is relevant to note that more enamel hypoplasia reflects an increase in the amount of "stress" affecting people, so therefore do the results imply that the amount of stress (infectious diseases, nutritional deficiencies and psychological stress) also increased across time? Today, we like to think that we have more stress (such as terrorism, global warming, crime, obesity, smoking, pollution, alcohol, financial problems, cancer, etc) than people in other eras. McKinley (1993:13) suggests that judging from the evidence of enamel hypoplasia the population at the Romano-British site of Baldock 1 was not under nutritional or chronic disease stress. The same was found by Roberts (1984) at the Romano-British site of Baldock 3. This research found that the mean prevalence of enamel hypoplasia was between 21% for individuals and 8.5% of teeth affected during the Romano-British period to 32.4 % for individuals and 24 % of teeth during the Late Medieval period, clearly, an increase through time.

Studies (Pindborg, 1970; Dobney and Goodman, 1991; Stroud, 1993) indicate that dietary deficiencies usually cause enamel hypoplasia. The high rate of enamel hypoplasia may reflect that some people were not able to access foods when they were growing perhaps due to sex differences, social status and availability; lack of protein, calcium, phosphate, trace elements and vitamins A, C and D, are all needed by the teeth for normal and healthy growth (Ortner and Turner-Walker, 2003).

Enamel hypoplasia has also been linked to climate and subsistence changes in prehistoric populations (Lukacs and Walimbe, 1998). Other factors associated with enamel hypoplasia are pollution, parasitic infection, emotional stress, childhood illness and weaning (Hood *et al.*, 1978; Suckling *et al.*, 1983; Lukacs, 1989; Saunders and Hoppa, 1993; Brothwell and Brothwell, 1998; Hillson, 1996, 2002).

It is possible to assume that as populations increased through time due to more births more children were weaned at some point introducing new pathogens and depriving children of important nutrients which could account for the increase of enamel hypoplasia from the Roman-British period to the Late Medieval period. Clayton *et al* (2006:311) mention that longer periods of breastfeeding extends interbirth spacing (observed on a contemporary Kalahari hunter-gatherer societies, the Kung women of Africa, where children are breastfeed until 3 or 4 years old), "so that fewer children are born to each woman, and the rate of population growth is limited". It is possible that during the Romano-British period more breastfeeding occurred compared to the Early and Late Medieval period. Therefore fewer children were born and less weaning took place, which contributed to the low incidences of enamel hypoplasia during this time. Fuller *et al* (2006a: 47) report that most of the children at the Roman-British site of Queenford Farm seem to have been completely weaned between ages 3-4 years, perhaps following the doctrines specified by the Roman doctors. It is possible that during the Early Medieval period less breastfeeding and weaning occurred; due to the small population when compared to the large population of the Late Medieval period, which explains the lower incidence of enamel hypoplasia during the Early Medieval period.

It appears that, as time progressed, access to food, social class differentiation, availability of food, climate and subsistence changed and pollution and diseases became more established, especially around urban centres. For example, the drastic changes in the weather system in Europe during the Late Medieval period brought with it not only the Great Famine of 1315-1322, but it affected the economy and society at all levels (Kershaw, 1973; Lamb, 1995; Simmons, 2001). The Black Death and other epidemics such as measles, mumps, leprosy, small pox, were accompanied by not only death but hunger, disease, malnutrition, disease and emotional stress (Gottfried, 1985; Byrne, 2004). Parasitic infection is also associated with enamel hypoplasia; loss of blood and intestinal infections can indirectly affect the development of the tooth enamel (Suckling *et al.,* 1983). During the Late Medieval period pollution was also a great problem

(Hanawalt, 1993). Increases in population and living in crowded places promoted the production of high quantities of human and disposal waste which contaminated water and food sources (Hanawalt, 1993; Dyer, 2000). The high rate of enamel hypoplasia during the Late Medieval period may be related to these and other dramatic changes in history. The Early Medieval period saw immigration of people from Europe and new diseases, epidemics (leprosy and small pox), environment and other factors which would also count for the high incidence of enamel hypoplasia during this time (Drewett *et al.*, 1988; Welch, 1992; Williams, 1996; Nutton, 2004). For example, Suckling *et al* (1987:1467) found a strong association between chicken pox, trauma and enamel hypoplasia. The psychological implications of all these factors and changes on people would have been very extreme, which in turn would have had affected the formation and development of the tooth enamel.

8.2.3 Stature

Results showed that for males and females stature increased from the Roman-British period (1.68m for males and 1.57m for females) to the Early Medieval period (1.72m for males and 1.63m for females), but slightly decreased during the Late Medieval period for males (1.71m), but the decreased was more prominent for females (1.59m). These data replicate (Table 8.3) what have been found in previous studies (Wells, 1963; Duhig, 1998; Roberts and Cox, 2003; Roberts and Manchester, 1997 and 2005). Roberts and Cox (2003:163, 195) indicate that male height during the Roman-British period was 1.69m and that female was 1.59m and that during the Early Medieval period was 1.72m for males and 1.61m for females. During the Late Medieval period the mean stature estimates were for males 1.71m and for females 1.59m (Roberts and Cox, 2003:248). According to Roberts and Cox (2003:195) the increase in stature during the Early Medieval period "suggests that nutrition was perhaps adequate, or if it was not then people were efficient at adapting to stress...and that some argue that the height increase may indicate the mixing of (taller) people from the continent. This cannot currently be proved". This new people introduced new genetic material to Britain which could have altered the height of the local population. However, it is important to note that it is very difficult to identify newcomers in the archaeological (skeletal) record (Budd *et al*, 2004).

	Alvaro Arce Research (2007)		Roberts and Cox (2003)	
	Male (m)	Female (m)	Male (m)	Female (m)
Romano-British	1.68	1.57	1.69	1.59
Early Medieval	1.72	1.63	1.72	1.61
Late Medieval	1.71	1.59	1.71	1.59

Table 8.3 Comparison of Stature Results from Alvaro Arce Research and Roberts and Cox (2003)

It is relevant to remember again that increased stature is usually associated with good health and nutrition during growth (Roberts and Cox, 2003).The question then is why is there a difference in stature between these periods? Clinical studies have demonstrated that height can be influenced by many different factors: diet (particularly its quality), psychological stress, disease, genes, socioeconomic status, environment, and climate (Frisancho and Baker, 1970; Nickens, 1976; Rimoin *et al.*, 1986; Hanson, 1992; Bogin, 1999; Roche and Sun, 2003; Önenli-Mungan *et al.*, 2004; Perola *et al.*, 2007). Today stature in England resembles that of the Early Medieval period and the recent increase in height when compared to the Late Medieval period has been related to accessibility and availability of early vitamin supplements, improvement in health care and prevention of childhood disease (Önenli-Mungan *et al*, 2004; Department of Health, 2005). Interestingly, results show that Early Medieval females were taller than modern females (figure 7.14-S); this result may support the idea of integration and recognition of females during the 7th-9th Century when "social primacy of kinship and comradeship favoured the acceptance of women" (Hollis, 1992:10) in society. Bitel (2002) clearly explains that during this period females had more opportunities and flexibility in society, women role and status allowed them to hold power and be involved in public affairs. There were aristocratic (queens), rich, military and monastic women (royal abbesses) (Fell, 1984; Hollis, 1992; Bitel, 2002). This social recognition encountered by women during this period allowed them to have access to food and resources which may have improved their nutrition and health (Bitel, 2002). Women increased in height may reflect this important factor. Without doubt this is a subject that requires further study in the future. On the other hand Early Medieval males are shorter than modern males, this is probably have to do with the increased stress (wars, disease, travel, contact, etc) suffered by males during this period. Modern males have better access to adequate diet, care and prevention of disease.

Diet during the Early Medieval period seems to have been constant and secure therefore, providing sufficient nutrients for the population. New comers to Britain came to stay and, it appears, adopted the agricultural economy of the native Briton population; techniques were not very different from those used on the continent and Scandinavia (Hanson, 1992; Roberts and Cox, 2003; Maat, 2005). This stability in diet may have allowed for an easy transition as well as preventing the introduction of a totally new diet. This, in combination with other factors, such as the introduction of new genes to the native population, less stress in the form of dental and skeletal stress markers contributed to the increase in height. It becomes clear, that people, during the Early Medieval period in England, had better health than the populations from the other periods. Despite the increase in trade during the Early Medieval period, products, especially food from across the Channel, were not very different from those found in Britain (Drewett *et al.*, 1988; Kelly, 1992). The economy was mainly based on agriculture and the exploitation of any available wild resources, and therefore daily food was basically baked bread, flour, cheese, milk, eggs and porridge and meat. Malim and Hines (1998: 292) note that the population at the Early Medieval site of Edix Hill had "no evidence of malnutrition" and the "height show[s] that the population was in general terms healthy".

During the Romano-British and the Late Medieval period things were very different. Despite the cultural interaction between the Romans and the native population, the Romano-British found themselves in stressful situations that they have not been in before (Scull, 1992; Welch, 1992; Fuller *et al.*, 2006a). The Romans were totally different in culture, diet, and customs to the local people. This introduced a high level of stress that probably led to the short stature found in this period (Fuller *et al.*, 2006a). Decrease in stature is usually associated with the transition to agriculture where it may reflect a decline in protein intake (Zakrzewski, 2003).

Thanks to the great expansion of trade and the establishment of markets during the Late Medieval period, a different diet was introduced (Hammond, 1993); it was more varied than that from the previous period. Components of the diet, such as sugar, dried fruits and new wines were introduced (Keene, 1989; Dallas, 1993; Sloane, 1999). Importantly, not only new foods and products were introduced with trade and travel but also diseases; the Black Death and other epidemics that devastated Britain during the Late Medieval period badly affected people physically and psychologically (Roberts and Cox, 2003). Psychological aspects of health have also been associated with short stature in some studies (Rimoin *et al.*, 1986; Önenli-Mungan *et al.*, 2004).

Several modern studies (Budnik and Liczbinska, 2006; Akachi and Canning, 2007) have associated shorter stature to urban living, low socioeconomic status, diseases, growing industry, high population density and difficult housing situations. Importantly, all these factors were present, in some proportion, during every period studied (James *et al.*, 1984; Grant, 1989; Dyer, 2000; Bennett, 2001), but perhaps more during both the Romano-British and Late Medieval periods. On the other hand, taller stature is sometimes found in individuals living in an urban setting, for example, those of modern Oaxaca, Mexico and Poland (Peña *et al.*, 2003; Budnik and Liczbinska, 2006).

There is a relationship between climate and body size and shape (Bergmann's and Allen's rules) (Ruff 1994; Baten, 2002). People living in equatorial or warm regions have a tendency for linear body proportions with longer limbs, and narrower trunks and they are tall. This body build maximises heat loss. On the contrary, people that live in polar or colder areas are in general of a stocky build, with a broad or larger trunk, shorter limbs, and are shorter in stature. However, the data from this research do not support this theory; evidence indicates that during the Romano-British period Britain was very warm (Simmons, 2001). On the contrary, during the Early Medieval period, the weather was colder and wetter than that of the Romano-British period (Hooke, 1998; Simmons, 2001; Rackham, 1993; Williamson, 2003). In other words, the Early Medieval population should have been shorter than the Romano-British population, but the results show that this is not the case. However, during the Late Medieval period it was colder than in the Early Medieval period (Kershaw, 1973; Lamb, 1995; Simmons, 2001); data show that people during this time were shorter, perhaps following Allen's rule, but this cannot be proved. However, the difference on effects of long-term and short-term climatic fluctuations in the body needs to be taken into consideration. Simply, long-term climatic changes would affect the body, while short-term climatic fluctuations would not (Ruff, 1994; Baten, 2002).

8.2.4 Cribra Orbitalia

Results show that cribra orbitalia decreased from the Romano-British period (9.3%) to the Early Medieval period (5.5%) and increased again during the Late Medieval period (10.5%). These data compare (Table 8.4) to those encountered by other studies. For example, Roberts and Cox (2003: 140) found that 8.05 % of individuals from the Romano-British period were affected by cribra orbitalia. It was suggested that this did not represent low iron intake as the Romano-British people consumed enough meat and fresh green vegetables. It is possible, that the presence of other diseases (e.g. infection and thalassemia) induced the appearance of cribra orbitalia, or that lead ingestion could be the cause (Waldron, 1982; 1983; Nriagu, 1983; Farwell and Molleson, Roberts and Cox, 2003). Pinter-Bellows (1993:87) suggests that malnutrition and lead intake are the possible causes of cribra orbitalia at the Romano-British site of Colchester, Essex. But it is important to note that the lead levels that can be found in some dental and skeletal remains could be contamination from the soil and lead coffins as skeletal tissue can absorb lead (Waldron, 1983). During the Early Medieval period 5.7 % of individuals were affected by cribra orbitalia; it was suggested that this condition is linked with settled populations and agricultural subsistence economies as the iron from plants are hard to absorbed (Roberts and Cox, 2003:185). On the other hand, during the Late Medieval period the prevalence of cribra orbitalia was 10.8 % (Roberts and Cox, 2003:234).

	Alvaro Arce Research (2007)	Roberts and Cox (2003)
	Individuals Affected (%)	Individuals Affected (%)
Romano-British	9.3	8.05
Early Medieval	5.5	5.7
Late Medieval	10.5	10.8

Table 8.4 Comparison of Cribra Orbitalia Results from Alvaro Arce Research and Roberts and Cox (2003)

Why is the prevalence of cribra orbitalia slightly lower during the Early Medieval period? If one assumes that cribra orbitalia indicates anaemia, or iron deficiency then a diet composed of meat and green vegetables should provide enough iron to avoid this type of anaemia (Monson, 1988; Stuart-Macadam, 1991; Tapiero *et al.*, 2001; Wapler *et al.*, 2004). The great amount of meat from cattle, deer, goats, pigs, deer, boar, rabbit and wild fowl and fish (Ayers, 2000) consumed during the Early Medieval period (as discussed above) could be one of the reasons for this decline in anaemia and cribra orbitalia during this period. Looking at the data, it is possible to suggest that, in general, during the Early Medieval period there were no severe dietary deficiencies. To illustrate the results, data from the Early Medieval period are presented. The lower rates of cribra orbitalia were found at five Early Medieval sites: Eccles (3.6 %), Nazeingbury (2.6 %), North Elmham Park (2.4 %), Great Chesterford (2.4 %) and the lowest prevalence being found at the Early Medieval site of Burgh Castle (2.0 %), and the highest rate was found at the Late Medieval site of St. James and St. Mary Magdalene Hospital, Chichester (21.1%) and at the Romano-British site of Baldock 1 (16.2 %).

A possible reason for the decline of cribra orbitalia during the Early Medieval period could be related to hygiene and food storage, which is supported by the large amount of pottery used during this period (Evison and Hurst, 1974; Kelly, 1992; Welch, 1992). Food and water could have been stored in clean and sealed containers avoiding the spread of infection by parasite eggs. Hygiene, perhaps introduced by the church, may have stopped contaminated hands reaching the mouth during eating. Pollution was also a problem during the Early Medieval period but perhaps not as bad as in the Late Medieval period (Hanawalt, 1993). It is important to mention that as leprosy was common during the Late Medieval period, some of the bone changes observed in the orbits during this time could had been caused by this disease (Møller-Christensen, 1961). Obesity and its relation to metabolic disorders were noted earlier (Isomaa, 2003; Misra and Vikram, 2007), the increased incidence of cribra orbitalia during the Romano-British and Late Medieval period may be related to obesity, it is known that during the Late Medieval period consumption of new foods and sugars along with an increase in sedentary life (urbanism) may have promoted the increase in obesity (Roberts and Cox, 2003), which could count for the increased in metabolic disease. Other conditions, for example, DISH (diffuse idiopathic skeletal hyperostosis), have also been related to obesity (Shingyouchi *et al.,* 1996; Hevelka *et al.*, 2001) and interestingly enough the incidence of DISH also increase during the Late Medieval period (Roberts and Cox, 2003) which supports the idea that perhaps people from this period were fatter than the previous periods. In addition the slight increased of both cribra orbitalia and DISH during the Romano-British period when compared with the Early Medieval period may also imply that the Roman-British people were fatter than the Early Medieval population. The varied food found in the Roman Empire may account for the gain on weight and the onset of metabolic disease.

The high incidence of cribra orbitalia during the Romano-British and the Late Medieval period may reflect the effects of urbanization and all the insecurities and pollution that came with it (Grant, 1989; Bennett, 2001). Perhaps some people were not able to access some foods such as meat and fresh green vegetables, perhaps due to illness, sex differences, social status and availability of foods. People consuming only vegetables would have had more chances of becoming anaemic as iron from plants is not easily absorbed by the body (Monson, 1988). Many other factors are associated with high incidence of anaemia during the Romano-British and Late Medieval period, For example, excessive blood loss or haemorrhage (Wapler *et al.*, 2004; Yildirim *et al.*, 2005) through injury, disease (e.g., infection, vitamin C deficiency, cancer or gastrointestinal problems), childbirth and menstruation can all lead to anaemia. Inadequate absorption of iron, due to diarrhoea, inadequate iron stores due to low birth weight, and a high consumption of cereal crops, which contain phytates which can inhibit the absorption of iron, can also contribute to anaemia development (Monson, 1988; Tapiero *et al.*, 2001). The data for cribra orbitalia suggests that during the Early Medieval period less blood loss "episodes" (parasite infections and injury) and infection occurred, which could have influenced the decline of cribra orbitalia during this period. It is possible that all these factors were in one way or another encountered more frequently during the Romano-British and Late Medieval period than the Early Medieval period due to the fact that the Romano-British and Late Medieval sites represent urban living and that the Early Medieval sites represent rural living.

Sullivan (2005) found an association between low status, females and anaemia in a Late Medieval population from York. Parasitic infection promoted blood and consequently iron loss, diarrheal disease and the development of anaemia. Women, for example, cannot maintain normal levels of iron and folic acid during the reproductive years due to menstruation, pregnancy and lactation, and the body uses iron to deal with reproductive demands, taking iron needed for other body functions (Sullivan, 2005). The increase in population during the Late Medieval times has been discussed and it is suggested that during this time, perhaps even more than the Early Medieval period, events such as pregnancy, childbirth and lactation occurred, again leading to the increased of anaemia during this time.

8.2.5 Tibial Periostitis

Results show that the frequency of tibial periostitis, slightly, but not significantly, decreased from the Romano-British period (5.7%) to the Early Medieval period (5.1 %) and increased again during Late Medieval period (14 %). To illustrate the results, the lowest rate of tibial periostitis was found at the Early Medieval site of Great Chesterford, Essex (0.6%) and the highest prevalence was found at the late medieval site of St. James and St. Mary Magdalene Hospital, Sussex (33.3%). Despite the fact that periostitis is commonly reported in skeletal populations, studies of tibial periostitis alone are not common. For example, Roberts and Cox (2003: 126-127) note that "on the basis of two (Romano-British) sites, that a high proportion of people were contracting non-specific infection... and that in all the periods it appears that periostitis affected many people" (Roberts and Cox, 2003), however, no specific data on tibial periostitis is presented.

Why the change during that Early Medieval period? One reason for the possible decline of tibial periostitis during the Early Medieval period could be related to the preservation of the bone. However, even though skeletal samples of eroded tibial shafts are common in skeletal samples, why do the Romano-British and Late Medieval skeletal samples have higher rate of tibial periostitis? Infections can cause tibial periostitis, however, it is common for infections to be under-represented in skeletal samples due to the fact that these infections usually affect soft tissues first and may never affect the bone (Roberts and Cox, 2003). Moreover, if infections are treated they can heal quickly and not affect the bone. Furthermore, infections could be fatal before changes on the skeleton can take place (Duhig, 1998:166), thus no evidence being seen skeletally (Wood *et al*, 1992). The general good health of the Early Medieval population in this study may have also helped to fight infections due to the strong immune systems.

It is important to remember that the data for cribra orbitalia perhaps illustrates that during the Early Medieval period fewer blood loss "episodes", which could have influenced the decline of cribra orbitalia during this period. Perhaps this was really the case, because the low frequency of tibial periostitis may indicate that fewer blood loss related injuries occurred. Fewer injuries could be associated with fewer bone infections and therefore less tibial periostitis. Data introduced by Roberts and Cox (2003) possibly demonstrate that fewer injuries occurred during the Early Medieval period when compared to the Romano-British and Late Medieval periods. Data from fractures (number of bones affected: including skull, clavicle, scapula, humerus, ulna, radius, hand and foot bones, ribs, spine, innominates, femur, tibia and fibula) and other trauma (including: cut-marks, dislocations, decapitations, os acromiale, weapon injuries, etc (number of individuals affected) show that during the Early Medieval period only 329 bones were affected by fractures, while in the Romano-British period 576 bones had fractures and during the Late Medieval people 506 bones had fractures. As for the number of individuals affected by other traumas during the Early Medieval period 93 individuals had some trauma, while 90 individuals were affected during the Romano-British period and 170 individuals during the Late Medieval period. Again, this data possibly demonstrates the low incidence of fractures and trauma during the Early Medieval period, which is reflected in the lower rate of tibial periostitis during this period.

Nevertheless, injuries did happen which may have contributed to tibial periostitis. For example, during all the periods considered agricultural work and other activities (metalworking, mining, wood, leather, pottery working, etc) were performed and these activities were performed more and more as populations increased through time and became more complex (e.g. needing more of these goods). The risk of injury to the lower legs was high. Trauma, if not treated, can lead to chronic infections which will prompt inflammation of the periosteum (Roberts and Cox, 2003). In addition, warfare occurred in every period studied and the possibilities of injury, infection and the development of periostitis were high. Malim and Hines (1998: 294) mention that many males at the Early Medieval site of Edix Hill were buried with weapons and also had evidence of stress markers. If these individuals were classified as warriors or members of an army they may have been involved in battles where injuries occurred therefore the possibility of developing infections and tibial periostitis were high. On the other hand, at the Late Medieval site of St. James and St. Mary Magdalene Hospital, Chichester, Sussex a high rate of tibial periostitis was found (Lee and Magilton, 1989; Magilton and Lee, 1989), the reason being that this is a leprous hospital cemetery and periostitis is one of the signs of leprosy (Møller-Christensen, 1961). It is important to note here that prevalence for the Late Medieval period is mainly influenced by the Chichester results. However, as leprosy was a common condition of the Late Medieval period (Møller-Christensen, 1961) data obtained for tibial periostitis needed to be taken in consideration. Other conditions (tuberculosis, scurvy and syphilis) can also stimulate the inflammation of the periosteum. Finally, it is important to note that the results observed for tibia periostitis reflects the fact that the Romano-British and Late Medieval sites represent urban living and that the Early Medieval sites represent rural living.

8.2.6 Age at Death Profile

Results show that the combined adult mean age at death increased through time: Romano-British (32.4 years), Early Medieval (32.6 years) and Late Medieval (33.7 years). Female mean age at death was highest during the Romano-British period (36.6 years), followed by the Late Medieval period (34.9 years), and lowest during the Early Medieval period (30.7 years). Male mean age at death was highest during the Romano-British period (38.2 years), followed by the Early Medieval period (34.1 years), and lowest during the Late Medieval period (32.8 years).

As previously discussed, it is difficult to be precise about these data, as the methods for ageing adult skeletal remains are inaccurate, and the information has been pooled from various skeletal reports completed by several bioarchaeologists; thus introducing inter and intra-observer error. However, as the mean age at death is provided by the reports, it has been used here to see if any relationship exists between the possible mean age at death provided and the general health of the people from the different periods. Nevertheless, caution is recommended with these data.

When looking at Table 7.22 ADP, it is apparent that through all the periods, the Middle Adults (26-35 years) had the highest percentages of death. However, when comparing the periods in the Middle Adult category, a significant drop can be seen between the Romano-British period (34.1%) and the Early Medieval period (28.7%). In addition, a dramatic increase in the Old Adults (45+) can be seen between the Romano-British (6.5%) and the Early Medieval (19.8%) periods. The Late Medieval period also had a slight increase in the deaths in the Old Adult category (21.1%). These data possibly show that in the Early and Late Medieval periods people were living longer and were therefore possibly healthier.

In Figures 7.8 ADP and 7.9 ADP patterns do emerge. When looking at the male age of death, there is a significant increase in deaths in the Young Adult (16-25 years) and Middle Adult (26-35 years) categories for the Early and Late Medieval periods. This could be due to warfare and events claiming the lives of the younger, stronger and more able males during these times, for example during the war between kingdoms and Viking war during the Early Medieval period and the Hundred Year' War against France (Duhig, 1998). Males tend to be more involved in travelling, trade and arduous occupations more often than the females, males aged between 16 and 35 years would have been involved in transportation, selling of goods, and employments at ports, markets and business centres. This may have exposed them to infectious diseases and injuries which could count for the increase in deaths in these age categories (Drewett *et al.*, 1988; Richards, 1999). However, there is also an increase in the Old Age category during these periods, indicating males were living longer and were possibly healthier during the Early and Late Medieval periods.

The female age at death, Figure 7.9 ADP, shows a large increase in females dying in the Young (16-25 years) and Middle Adult (26-35 years) categories in the Early and Late Medieval periods compared to the Romano-British period. These years, 16-35, are the primary child bearing years and so it is logical to expect more females dying because of childbirth hazards during these years (Joshi, 1990; Pinter-Bellows, 1993; Duhig, 1998). This situation has been observed in modern developing countries (e.g. India and Guinea-Bissau, West Africa). In India for example, between 63-80 % of female death are attributed to childbearing between the ages of 16-35 years (Joshi, 1990) and in Guinea-Bissau there is a high female mortality within the three months of delivery (Høj, 2003). Maternal death is associated with haemorrhage, infection, obstructed labour and harsh living conditions (Joshi, 1990; Høj, 2003).

Without doubt, historical events that occurred during the Early and Late Medieval times (e.g. wars, famine, epidemics, etc) would also have played a part in loss of life. Importantly, there also was a marked increase in the Old Adult (45+) category for females during the latter two periods. Again this may indicate that females were living longer and were therefore healthier during the Early and Late Medieval periods.

When comparing the mean age at death (Table 7.23 ADP and Figure 7.11 ADP) between males and females, it can be seen that males lived slightly longer than their female counterparts in the Romano–British and Early Medieval periods. Meanwhile, in the Late Medieval period, females began to outlive the males, which is similar to today where women are expected to live to around 81.1 years and males to around 76.7 years (National Statistics, 2006). However, it is important to note that today the gap between male and female life expectancy is closing; due to the fact that females are drinking, smoking and suffering stress more than males (National Statistics, 2006). After calculating the mean age at death for all adults in each period, Figure 7.12 ADP shows that populations lived longer lives as time progressed, with a large increase during the Late Medieval period.

Important information related to age at death in the skeletal reports considered includes: the Romano-British sites of Baldock 1, Colchester, Essex and the Eastern Cemetery of Roman London where juveniles were under-represented, perhaps reflecting the custom of burying juveniles outside the city walls (Henig, 1989; McKinley, 1993; Pinter-Bellows, 1993; Conheeney, 2000a, 2000b; Bennett, 2001). This under-representation of juveniles can also be caused by the fact that bones from young individuals are very fragile which could easily be affected by post-mortem change (Wood *et al.*, 1992; McKinley, 1993). Conheeney (2000a, 2000b) suggests that infanticide could also have been a problem in the Romano British period leading to the under-representation of juveniles in this period. On the other hand, Browne (no date) states that part of the Romano-British cemetery at Winchester included infant burials. This under-representation of juveniles has also been observed in Early Medieval sites (Edix Hill) (Duhig, 1998), but this was not the case at Great Chesterford where a high number of juveniles were present (Evison, 1994:50). The under-representation of juveniles is the reason why juveniles were not considered in this research.

8.3 Psychological Stress and An Alternative Hypothesis

8.3.1 Psychological Stress

(i) Introduction

Selye (1976: 370) notes that "among all living beings, man has the most complex brain and is the most dependent upon it". Today, psychological stress is one of the main factors affecting people's lives and it would be unrealistic to presume that in the past people were not influenced by it. Psychology and its relation to paleopathology and archaeology are not often studied in the literature (Hyland and Scutt, 1991). However, it is very important to bear in mind psychological factors or psychological stress when examining indicators of stress. This kind of stress could also indirectly produce changes on the skeleton. However, it is very difficult, if not impossible, to identify changes that have been produced by psychological factors in skeletal remains. Nevertheless, inferences can be drawn by considering factors that might encourage the development of psychological stress.

For example, socioeconomic factors such as unequal and inappropriate access to economic and social resources could, without doubt, promote and increase psychological stress (for example the feeling of lost of control), which in time could affect the body's immune system, making an individual a target for climatic, infectious and biological stressors, which could manifest themselves as a disease, or even lead to death (Goodman *et al.*, 1988; Hyland and Scutt, 1991). Sometimes, mental breakdowns and migraine headaches are caused by work, and situations which people are not adapted to or prepared for (Selye, 1976:247). Occupational stress can be experienced by anybody, but it affects people in different ways: depression, anxiety, high blood pressure, coronary heart disease, bronchitis, breast cancer, arthritis, backache, asthma, hay fever, indigestion, constipation, piles, bunions, ingrowing toenails, varicose veins, problems with the gums and mouth, cough, diarrhoea, dizziness, earache, swollen ankles, rashes and even negative moods may all be reflected as induced by occupational stress (Janisse, 1988). Today, more people stop going to work due to mental stress than for physical illnesses (Smith *et al.*, 2000). Stress at work seems to be related to several factors: hours of work which includes shift work and long working hours, also, characteristics of the job, support at work, pressure at work, job security and family/work interface (Smith *et al.*, 2000; Orth-Gomer and Leineweber, 2005). Interestingly, individuals who have full-time work are more stressed than individuals in part time work and they are more susceptible to taking painkillers, medicine for indigestion, sleeping pills, antidepressants, and laxatives (Cohen, *et al.*, 1993; Smith *et al.*, 2000; Orth-Gomer and Leineweber, 2005).

Another study shows that there is a strong correlation between war experience and post-traumatic stress disorder and psychosis, for example, British war veterans also showed an increase in negative appraisals of themselves and the world after being in combat (Campbell and Morrison, 2007). Migrating and travelling to new areas or countries place individuals into stressful situations where they have to deal with wars, conflict, a new diet and new language, a different climate, new diseases, poverty, and new cultures and religions (Selye, 1976; Leavey *et al.*, 2007). Individual cultural groups share similar characteristics (e.g. loyalty, diet, cooperation, hierarchies and identification) that contribute to the efficiency, productivity and survival of their culture (Selye, 1976; Matsumoto, 2007:413). However, when people move to new areas the important characteristics that keep them united can be altered, increasing levels of depression, feelings of alienation, family conflict and anxiety (Leavey *et al.*, 2007). Leavey *et al.* (2007:232) give the example of Irish- born people living in London; interestingly these individuals have poorer health (depression, suicidal behaviour and mental illness) than any other immigrant group. This has been linked to social selection, material deprivation, problems related to culture, identity and racism (Leavey *et al.*, 2007). Only a "positive relationship to both the culture of origin and the current culture (integration)… provided the strongest socio-cultural foundation for good mental health" (Stevens *et al.*, 2007:310).

Even though today, the popular use of the term "stress" refers to a sense of nervous and emotional strain (Bush, 1991). In paleopathology, skeletal and dental indicators of stress are usually associated with changes in diet and biological factors, but not related to psychological stress. It seems to be easier to blame the cause of skeletal and dental disease to a physical factor rather than to a factor of the mind which is intangible i.e. cannot be specifically identified. Some diseases are not caused by one thing in particular, but they are the result from the body's own response to an unusual situation (Selye, 1976: 179). The achievement attained by humans during life depends not only on the biological characteristics of the person, but also on its behaviour. Therefore, psychology must be relevant to an interpretation of the archaeological (Hyland and Scutt, 1991) and paleopathological record. Furthermore, Simmons, (1991:8) suggests that "our minds do, though, carry a great deal beyond the material; they are clearly the seats of emotions…they are also repository of social behaviour, in which submit our individuality to the greater sanctions of the group. Further, humans are probably unique among animals in having an extended concern for the future".

In a study by Eller *et al.* (2006) the association between psychological stress and salivary cortisol excretion were studied in order to measure the fluctuations in the level of cortisol produced by stress. The level of cortisol (adrenal-cortex hormone) in the saliva is very constant. However, when stress occurs (e.g. working overtime, lower social class pressures, and when there is an increase in pressure in daily life, leading to anxiety and depression) the level of cortisol increases. Interestingly, Brooke-Wavell *et al.* (2002) found a relationship between raised levels of cortisol and bone density in pre-menopausal women. Interestingly, women who had high levels of cortisol also had low bone density, raising the risk of osteoporotic fractures. However, a study by Vedhara *et al.* (2003) demonstrated that no association existed between high levels of cortisol and psychological stress. The study documents that, during the day, there is always a variation between the levels of cortisol between and within individuals and that this level varies depending on the time of the day the measurement is taken, and also medication and food intake influences cortisol levels.

As can be observed, the way a person feels psychologically, could influence the appearance and onset of a disease. On the other hand, it could also control recovery from the illness. To a psychologically unstable and unbalanced individual, with the body defences down, a simple cold or influenza could have devastating consequences. However, to a stable and secure person, this would not be significant. Casey (2005:15) notes that individuals with psychiatric disorders tend to have higher rates of respiratory illnesses, infectious diseases, obesity, diabetes and cardiovascular disease. Interestingly, bereavement can increase mortality in the remaining spouse, as well as the production of adrenalines and of corticoids (Selye, 1976; Hyland and Scutt, 1991). Additionally, as mentioned above, Önenli-Mungan *et al* (2004) give the example of a nine year old girl with severe depression which eventually affected her stature. Clinical depression affects neurotransmitter activities, which in due course impair the secretion of growth hormones, thereby affecting growth. Rightly, Bush (1991) explains that bone is a sensitive tissue that in times of stress could arrest its growth and development. The relationship of psychological stress and stature was also confirmed by Powell *et al* (1967a, 1967b) in their study of children from unstable homes. They suffered from short stature due to insufficient pituitary gland hormone secretion. Interestingly when the children were moved to a stable and favourable home, without the administration of hormones, normal growth resumed.

Importantly, suffering from a disease would also affect the psychological state of any individual. Any pathological condition would influence, in one way or another, the actual state of a person's mind (Janisse, 1988; Hyland and Scutt, 1991; Hyland, 1993). However, in normal life, emotional and mental distressing situations are more common than other stressors, such as diseases, colds, injuries, etc (Selye, 1976). Hyland and Scutt (1991:26) suggest that "an unhealthy psychological state includes: depression, loneliness, anxiety, hostility and anger, inability to express emotion including inability to express hostility, suspiciousness, and time pressure. Healthy psychological states include social support, optimism, affiliation motivation and effective coping styles including hardiness, commitment and control". Selye (1976: 174-177) gives a list of different responses, symptoms or signs that an individual suffering from stress could experience (Table 8.5).

It is important to bear in mind that not every person suffering from psychological stress will show these signs and symptoms of stress, but similarities could be found between them (Selye, 1976; Janisse, 1988).

Psychological stability exists when cooperation and social interaction between individuals occur. In other words, a certain level of common sense is needed when societies work together in economic, production, religious, and social levels (Hyland, 1993). For example, the maintenance of land for farming and pastoral activities in recent and past societies demonstrate that mental unity, in this case working for a purpose, being it to obtain food or to supply the markets with goods, exists or existed. Nevertheless, when a sector of the unity is uncooperative, and psychologically unbalanced, productivity is affected (Hyland and Scutt, 1991; Hyland, 1993). A good social environment, with interactions occurring at different levels (intimate, inter-personal and general society and community) is needed for good health. However, it is important to bear in mind that psychological stress can be experienced at any of the levels mentioned (Bush, 1991).

1. General irritability, hyperexcitation, or depression which is associated with unusual aggressiveness or passivity and inactivity.	2. Pounding of the heart, an indicator of high blood pressure often due to stress.
3. Hypermotility (hyperkinesias) an increased tendency to move about without any reason.	4. Sweating.
5. Dryness of the throat and mouth.	6. Frequent need to urinate.
7. Impulsive behaviour, emotional instability.	8. Diarrhoea, indigestion, queasiness in the stomach and vomiting- all signs of disturbed gastrointestinal function.
9. The overpowering urge to cry or run and hide.	10. Migraine headaches.
11. Inability to concentrate, flight of thoughts and general disorientation.	12. Premenstrual tension or missed menstrual cycles- indicators of severe stress in women.
13. Feelings of unreality, weakness, or dizziness.	14. Pain in the neck and lower back- due to increased muscular tension.
15. Fatigued.	16. Loss or excessive appetite which shows as alteration of body weight. Loss of appetite during times of stress due to gastrointestinal malfunction, whereas others eat excessively, as a kind of diversion, to deviate their attention from the stressor situation. A full stomach and intestine shift blood to the abdomen, resulting in a decrease of circulation to the brain which tranquilizes by decreasing mental alertness.
17. Anxiety.	18. Increased smoking.
19. Emotional tension and alertness.	20. Increased use of drugs (tranquilizers or amphetamines).
21. Trembling, nervous ticks.	22. Alcohol and drug addiction- help to forget the cause of the distress- gives elation or tranquilization.
23. Easily startled by small sounds.	24. Nightmares.
25. Stuttering and other speech difficulties which are frequently stress-induced.	26. Neurotic behaviour.
27. Bruxism (grinding of the teeth).	28. Psychoses.
29. Insomnia.	30. Accident prone.

Table 8.5- Signs and Symptoms of Psychological Stress

According to Smith *et al.* (2000:4) the increase of stress encountered today, may be the result of "increased awareness of stress, changing attitudes to stress and changes in social and economic conditions". This global interest in psychological problems and stress has encouraged new studies. For example, new research by Gidron *et al.* (2006) has found a relationship between psychological factors (depression, coping and stress) and DNA-damage in humans and other animals. DNA-damage or breakage of the strands of entwined proteins can lead to the mutation of genetic information and normal cellular functioning, generating diseases such as cancer, heart disease, diabetes, atherosclerosis and neurodegenerative diseases. "Damage to DNA can inhibit the cell's ability to repair itself or prevent disease...damage to a tumour-suppressor gene may increase the chance of developing cancer" Gidron *et al* (2006:291). In humans, stress such as those related to taking exams, noise, tension, and anger, the quality of the relationship with parents in the early years, caring for an ill child, anxiety, negative moods and bereavement were studied. These stressors were found to affect chemicals involved in DNA synthesis and reduced repair of DNA-damage. "Psychological factors can increase levels of norepinephrine and norepinephrine can induce DNA-damage by causing oxidative stress (Gidron *et al.*, 2006:302).

As discussed above, a positive stimulus can also affect body functions. A study by Light *et al* (2004) has found a relationship between partner hugs and low blood pressure, leading to lower risk of cardiovascular disease. Positive communication and emotional support (positive facial expressions, body language, hugs and words) between partners increased the level of oxytocin activity which is a hypothalamic neuropeptide involved in social behaviours. Enhanced oxytocin is associated with lower blood pressure (Light *et al.*, 2004). Perlman (2007:7) indicates that "dating back to Aristotle, humans have been described as a social animal" and that relationships are essential for the mental and physical health of people. The lack of a positive relationship has been linked to depression, more sick days from work and early mortality (Perlman, 2007). Interestingly, married and socially integrated individuals live longer than those who are unmarried and also have more positive attitudes. Perhaps as a result of feeling emotionally secure and supported. On the other hand, relationships could also be detrimental to an individual. Factors such as jealousy, divorce, violence, unreasonable demands, and offensive and nonverbal behaviour, deception and conflict can produce adverse psychological damage that could be reflected as depression and anxiety. However, in general relationships are more positive than negative (Light *et al.*, 2004; Perlman, 2007).

An area that is usually ignored in paleopathological studies is the relationship between religion and psychology. During the entire history of humans, there has always been a spiritual and psychological connection to a religion or ritual activity (Woods *et al.*, 1999). This connection appears to be beneficial to the emotional well-being and health of people. People who perform the same religion or rituals have a tendency for socializing more than people with no religion (Levin, 1994). The sense of belonging to a group that follows your beliefs provides ways to deal and cope with stress and bereavement. Support, and help, and a belief in miracles and similar attitudes and behaviour are positive factors found in a religion (Woods *et al.*, 1999). The elderly seem to find the most psychological benefit from practicing religion. At the place of worship older people are acknowledged as members of the society; this is often difficult to achieve in society as a whole (Levin, 1994; Woods *et al.*, 1999). A study by Woods *et al.* (1999:165) found that "placing trust in God, seeking comfort in religion, service attendance, prayer, and spiritual discussion" is associated with low levels of depression and higher T-helper-inducer cell (CD4+) counts and percentages which promote a strong immune status in HIV positive individuals. Interestingly, Roberts and Cox (2003:253) note that today, there is still a common practice in the Anglican burial tradition to bury dead infants with a recently deceased female. It is possible that the main reason for this is to ease the psychological stress that living family members of the infant are experiencing; in other words, the infant is not alone in his/her death bed, but is accompanied by a female adult.

In the past, psychological problems were recognized. For example, Brothwell and Brothwell (1998:122) note that during the Romano-British period, watercress was eaten with vinegar as a cure for mental complaints and during the Late Medieval period some hospitals concentrated on the care of the mentally ill and "lunatics", For example St. Mary of Bethlehem hospital in London (Rawcliffe, 1999). Jolly (1996:135) mentions that during the Early Medieval period "Elf-disease remedies appear in close proximity to or combined with remedies for demon possession, nightmares, madness...and other mind-altering afflictions...". For example, for the wooden heart (frenzy and anxiety) bishopwort (betony), lupin, bonewort, everfern, githrife, heahhoolothe, sung over with Christian litanies and blessed in the church on the altar was recommended (Leechbooks I: Ixiv elf remedies) (Jolly, 1996:148) and for mind-altering affliction produced by fever have "Feverfue, ram's gall, fennel, waybread. Let a man sing many masses over these herbs..." (Leechbooks I: Ixv elf remedies) (Jolly,1996:150). Leechbook III:xxxix recommends "In case a man be lunatic; take the skin of a porpoise, make it into a whip, and whip the man with it; he will soon be well".

Psychological stress can be caused by many factors, but specifically, the pressure, tension and worry of war, occupation, migration, travel, social inequality, urbanization, catastrophies and related diseases. Furthermore, psychological problems may be the predisposing factor for certain pathological conditions seen in human skeletal remains.

(ii) Psychological Stress: Discussion

The possible association between psychology and health also needs to be taken into consideration. It is clear that a relationship exists between these two factors (Selye, 1976; Cohen, *et al.*, 1993; Smith *et al.*, 2000; Orth-Gomer and Leineweber, 2005). In clinical studies the study of disease emphasises areas where physical or tangible causes can be studied. A negative aspect of looking at the relationship between psychological stress and health is that, when studying skeletal remains, it is not possible to link a particular paleopathological condition to psychological disorders, which has contributed to the alienation of the study of mental health in paleopathology.

If the stress markers and psychological stress studied here were to be ranked in severity from one to ten (one being less severe and ten more severe) based on their cause and effect to individuals and society, psychological stress would be above all of them with a grade of ten, followed by the devastating effects of anaemia and dental caries with a grade of eight. Tibial periostitis would be next with a grade of six, followed by stature reduction with a grade of four, ending with enamel hypoplasia with a grade of two. Psychological stress can affect the onset of every stress marker considered and the severity of each condition can be controlled by how an individual feels psychologically (Önenli-Mungan *et al*, 2004; Casey, 2005). When the members of a society are affected psychologically by climate change, diet, disease, etc society is also affected; in consequence economy, trade, production, communication can also be affected (Selye, 1976). This important detail is not recognized in paleopathological studies.

Clinical data has shown that factors such as travel, migration, warfare, environmental changes and catastrophes, socioeconomic factors, catastrophes, disease, diet (quality and the lack of food), occupation, positive stimuli, religion, etc (Selye, 1976; Janisse, 1988; Cohen, *et al.*, 1993; Levin, 1994; Woods *et al.*, 1999; Smith *et al.*, 2000; Light *et al.*, 2004; Önenli-Mungan *et al.*, 2004; Casey, 2005; Orth-Gomer and Leineweber, 2005; Gidron *et al.*, 2006; Leavey *et al.*, 2007; Perlman, 2007) can influence in one way or another the well-being of a person. Importantly, all these factors were present in the past.

To say which of the three populations studied here suffered more psychological stress is inappropriate and impractical. The important thing is that during all the periods, as today, many situations and circumstances were present where psychological stress could have occurred. For example, it is possible that the migration and travel of people from the continent to and from Britain during the Roman-British, Early and Late Medieval period put populations into stressful situations; as with travel, people are exposed to new diseases (e.g. rabies, avian influenza, malaria, dengue, hepatitis A, tuberculosis, syphilis, etc), changes in altitude, humidity and temperature (World Health Organization, 2007). The Roman invasion brought to England many people, who encountered resistance by locals, a new environment and new diseases. However, the Roman impact (physical and psychological) on the native population also needs to be taken into consideration. Issues such as warfare and captivity may have led to mental instability (post-traumatic stress disorder and psychosis) such as found by Campbell and Morrison (2007).

It is important to remember that in AD 367 the Roman army was moved to areas around the coast; this left the countryside unattended and it succumbed to riots and invasions, a situation that left the country affected by unrest, economic and political problems (Applebaum, 1958) and this is just another event that could be associated with psychological stress. In a previous section, the great Famine of 1315-1322 AD and the 14th century Black Death were described. As well as any of the other epidemics encountered by people, the emotional effects of these events and diseases were without doubt immense. Not only the mental well-being of society was affected by famine and death, but also by discrimination, such as the leprous in the Late Medieval period being a segregated community, who were categorised as sinners (Rawcliffe, 1999). The emotional and psychological impact of this prejudice would have been devastating and probably suffered by many individuals buried in St. James and St. Mary Magdalene Hospital, Chichester (Lee and Magilton, 1989; Magilton and Lee, 1989). The link between psychological stress and the onset of or recuperation from, diseases had been noted above (Önenli-Mungan *et al.*, 2004; Gidron *et al.*, 2006).

As previously mentioned, during the Early Medieval period people also encountered travel, migration, environmental change, flooding, wars, diseases such as leprosy, famine and poor diets, and misery, factors that today have contributed to the onset and development of mental disease. For example, several studies (Cohen, *et al.*, 1993; Smith *et al.*, 2000; Orth-Gomer and Leineweber, 2005) have demonstrated a link between psychological stress and occupation. During all the periods studied, people worked for a living and people were exposed to different pollutants and injuries (e.g. fractures, cuts and burns) (Roberts and Cox, 2003), but also to long working hours, lack of support at work, pressure at work, job insecurity, etc (Cohen, *et al.*, 1993; Smith *et al.*, 2000; Orth-Gomer and Leineweber, 2005). This would have promoted the development of depression, anxiety, high blood pressure, indigestion, etc (Janisse, 1988; Cohen, *et al.*, 1993; Smith *et al.*, 2000; Orth-Gomer and Leineweber, 2005).

The levels of mental breakdowns, migraine headaches, depression, anxiety, or any of the symptoms and signs listed by Selye (1976:174-177) cannot be measured in archaeological populations, but without doubt they had an impact on the onset and development of the dental and skeletal stress markers studied. In every period, people would have suffered psychological stress at different intensities and it needs to be regarded as a possible causal factor for the appearance of indicators of stress.

The importance of religion in the lives of past people and today, cannot be forgotten, from the beliefs in the Olympian and Classical gods in the Romans, to Romano-Celtic religion, and to the adoration of natural and supernatural forces and building of temples and shrines, to the introduction and establishment of Christianity with its churches, monasteries and laws (Henig, 1989; King, 1991, Bennett, 2001; Nutton, 2004); religion has always been part of humanity. Its association with psychology is unmistakable (Levin, 1994) as it offers a sense of belonging to a group but also ways to deal and cope with stress and including bereavement. Religions introduce support, help, positive influence, belief in miracles and similar attitudes and behaviour (Woods *et al.*, 1999).

During the Romano-British period the cult of Mithras offered commitment, courage, and honesty (Bennett, 2001), all which are mental emotions and sentiments. The offerings to the gods given by the Romano-British (Henig, 1989), also illustrate emotional reasons to perform the act. For example, the feeling and belief that by placing coins or jewellery into a shrine would protect cure or simply lead to a good life, supports the idea that people understood the importance of the "mind" in life. Furthermore, during the Romano-British and Early Medieval periods the possible positive psychological effect of placing grave goods with burials should be discussed (Henig, 1989; King, 1991; Welch, 1992; Lucy, 2000; Bennett, 2001). The idea was to provide the dead with food, jewels, vessels and clothes for the afterlife (Welch, 1992; Lucy, 2000). However, behind all this is the reality that death of a loved one could overwhelm and devastate anybody and the placement of grave goods with the dead could have provided a sense of security and psychological stability to the living relatives that the dead would be safe. Archaeological reports always link grave goods to status, but their placing may have only been done for the mental well-being of the living. Interestingly, Going (1993:23) notes that pottery in burials confer good luck to the dead in the journey to the afterlife, and Pinter-Bellows (1993) indicates that most of the child and female burials at the Romano-British site of Colchester had some kind of offering in their graves. Evison (1994) confirms that artefacts (swords, pottery, glass vessels, etc) were buried with the dead at the Early Medieval site of Great Chesterford and also at the Early Medieval site of Edix Hill (spear head, buckle, glass and amber beads, etc) (Duhig, 1998).

Previous discussion suggested that positive stimuli (hugs, positive communication and emotional support) can also affect the body (Light *et al.*, 2004). Perlman (2007: 7) describes that humans are social animals and socialisation is essential for the mental and physical health of people. Without doubt, at any period in the history of the human being, socialisation has occurred. Imagining an Early Medieval period market and town without relationships, and social situations is impossible.

Finally, even though dental and skeletal stress markers were found during the Early Medieval period, their overall prevalence was not as great as those found during the Romano-British and Late Medieval period. This replicates and gives stronger evidence to what has already been described in the literature. The evidence obtained for stature, dental caries, cribra orbitalia, tibial periostitis and age at death suggest that the population of the Early Medieval period did not suffer severe physiological and psychological stresses and therefore, it appears that the Early Medieval population in England was healthier than preceding and subsequent periods.

8.3.2 An Alternative Hypothesis

It is important to remember that after a period of stress, the changes presented in the skeleton are the result of adaptive responses of the individual to stressors (Selye, 1976; Goodman *et al.*, 1988; Bush, 1991; Roberts and Manchester, 1997; Wapler *et al.*, 2004). The function of the response is to maintain homeostasis, or balance of the body's physiological or anatomical systems (Bush, 1991). Duhig (1998) notes, that the presence of cribra orbitalia could confirm the good health of a population, as cribra orbitalia is an indication of a strong bodily immune response (as generally discussed by Wood *et al*, 1992).

The alternative hypothesis then is that the higher rates of enamel hypoplasia, cribra orbitalia, and tibial periostitis are actually indications of good health and of strong immune defence mechanisms. In these three conditions, the body is trying to counteract the effects of a pathogen or injury and compensate for the lack of nutrients by causing inflammation and leading to tibial periostitis (Resnick, 1995; Aufderheide and Rodríguez-Martín, 1998). Cribra orbitalia reflects the body's effort to create more new red blood cells in the bone marrow to balance the lack of iron (Stuart-Macadam, 1985a; Kent *et al.*, 1994), and enamel hypoplasia records an episode of stress that affected the teeth (Lukacs, 1989; Hillson 2002); enamel hypoplasia occurs following recuperation from stress and consequently showing a strong immune system.

Taking the actual hypothesis into consideration (Table 8.6) and excluding psychological stress (for reasons described above), it is clear that, of the six categories of dental and skeletal stress markers studied (stature, dental caries, enamel hypoplasia, cribra orbitalia, tibial periostitis and age at death), five (stature, dental caries, cribra orbitalia, tibial periostitis and increased age at death) point to a healthy life during the Early Medieval period. On the other hand, for the Romano-British only two conditions (enamel hypoplasia and increased age at death) indicate good health and for the Late Medieval period only one (increased age at death) has a positive outcome. This comparison shows that the population studied here during the Early Medieval period seems to have been healthier than the other periods.

Actual Hypothesis

Romano British	Early Medieval	Late Medieval
Enamel Hypoplasia ↑	Stature ↑	Age at Death ↑
Age at Death ↑	Dental Caries↓	
	Cribra Orbitalia↓	
	Tibial Periostitis↓	
	Age at Death↑	

Table 8.6 Dental and skeletal stress marker patterns implying good health (Actual Hypothesis) ↑ = Increased ↓ = Decreased

Alternative Hypothesis

Romano British	Early Medieval	Late Medieval
Enamel Hypoplasia ↑	Stature ↑	Enamel Hypoplasia ↑
Cribra Orbitalia↑	Dental Caries↓	Cribra Orbitalia↑
Tibial Periostitis↑	Enamel Hypoplasia ↑	Tibial Periostitis↑
Age at Death ↑	Age at Death↑	Age at Death ↑

Table 8.7 Dental and skeletal stress marker patterns implying good health (Alternative Hypothesis) ↑ = Increased ↓ = Decreased

Combine Actual Hypothesis and Alternative Hypothesis

Romano British	Early Medieval	Late Medieval
Enamel Hypoplasia ↑	Stature ↑	Enamel Hypoplasia ↑
Cribra Orbitalia↑	Dental Caries↓	Cribra Orbitalia↑
Tibial Periostitis↑	Enamel Hypoplasia ↑	Tibial Periostitis↑
Age at Death↑	Age at Death↑	Age at Death ↑
	Cribra Orbitalia ↓	
	Tibial Periostitis ↓	

Table 8.8 Dental and skeletal stress marker patterns implying good health (Combine Actual Hypothesis and Alternative Hypothesis) ↑ = Increased ↓ = Decreased

Now taking the alternative hypothesis into consideration (Table 8.7), the population samples from all the periods indicate a level of good health for four indicators: for the Early Medieval period they include stature, dental caries, enamel hypoplasia and increased age at death; and for both the Romano-British and the Late Medieval period, enamel hypoplasia, cribra orbitalia, tibial periostitis and increased age at death. This comparison shows a level of good health similar for all the periods. The evidence considered (clinical, pathological, psychological, historical and archaeological) that has been discussed in this chapter does not support this finding, stating that health and disease across all the three periods was similar is not supported. It is clear that changes in the rates of dental and skeletal stress markers occurred over time.

If a combination of both hypotheses is considered (Table 8.8), it is evident that the Early Medieval period shows better health in all the categories and the Romano-British and Late Medieval period have four positive outcomes. Importantly, the combined approach also shows that during the Early Medieval period people appear to have had better health than the other periods. The reasons for this possible improvement of health during the Early Medieval period have been discussed above.

Are the results indications of good health or are they implying that less disease was present? It is however, important to remember that if a skeleton does not display any marker of stress, it may indicate that the individual was very healthy so that stressors did not produce an adaptive skeletal response, or that the individual was continually stressed and never recovered to display a skeletal stress marker before the person died (Wood *et al.,* 1992; Roberts and Manchester, 1997:164).

Chapter 9: Conclusions

9.1 Summary of the data

The aim of this research was to study the health of the Early Medieval population (AD 450 AD-AD 1066) in Britain and compare the results with the health of the Romano-British (AD 43 – AD 450) and Late Medieval (AD 1066 – AD 1600) people. Previous studies have shown that during the Early Medieval period stature increased and the rate of dental caries decreased, compared to the Romano-British and Late Medieval periods. One of the purposes of this study was to corroborate these results. In other words, would the results on stature and dental caries resemble the outcome of the previous studies? Yes, the data collected and analysed confirmed that people during the Early Medieval period were taller than the Romano-British and Late Medieval populations and that the rate of dental caries was lowest during the Early Medieval period. It appears that during the Early Medieval period stature was affected by factors such as adequate nutrition, providing enough nutrients and supplements, and efficiency of adapting to stress (general good health when compared to the other two periods) and stability of the diet which allowed an easy transition between lands and environments. On the other hand, during the Early Medieval period dental caries were prevented by the effective oral hygiene (encouraged by family and friends), diet high in proteins (expansion in the consumption of meat), less fermentable carbohydrates in the diet than for any of the other periods, and the consumption of food with low dental caries risk and anti-cariogenic effects (fish, bread, water, fresh fruit, cheese and milk).

Would results for the other markers of stress support the idea that people during the Early Medieval period were healthier than the people from other periods? Yes, data on cribra orbitalia, tibial periostitis and increased age at death corroborate the fact that people during the Early Medieval period experienced good health. The decrease in cribra orbitalia during the period in question was influenced by factors such as a high iron intake (meat and green vegetables), no lead ingestion like in the Romano-British period, less sedentary population , less obesity compared to the Late Medieval period, which encouraged the consumption of agricultural products which provided iron that was hard to absorb by the body, better hygiene and food storage which prevented parasite infection, less blood loss due to injuries, and less pollution compared to the Late Medieval period. The decrease of tibial periostitis was also possibly influenced by fewer injuries which prevented infection and periostitis, and general good health which encouraged the healing of infections before it reached the bones. The increase in the age at death demonstrates that in every period, males were dying more often during the young and middle adult category, which corresponds with the age at which they might have been involved in warfare, travelling, trade and other occupations could have led to trauma, disease and death. In addition, females died more often within the young and middle adult category which coincides with the childbearing years. Interestingly, the data shows that males outlived females during the Romano-British and Early Medieval periods, but females lived longer during the Late Medieval period.

On the other hand, results for enamel hypoplasia showed a different picture, the rate of enamel hypoplasia increased during the Early Medieval period. Deficient diet could have been the cause; episodes of malnutrition could count for lack of protein, calcium phosphate and other elements needed for normal teeth growth. Also episodes of disease and the increase in the amount of stress across time (For example, infectious disease, psychological stress, access and availability of food, climate and subsistence changed, pollution (parasite infection) increased in the population) could account for the increased of enamel hypoplasia through time. Another possible explanation was also presented which is related to the duration of breastfeeding provided, weaning and the high incidence of enamel hypoplasia across time.

Is there anything new that can account for the changes? Yes, psychological stress and its association with the onset, development, and recovery from disease have also been studied. The way an individual feels psychologically, will influence life in general. Even though it was not possible to determine which period suffered more psychological stress than the other, a series of factors are common in all the periods which could be assumed to have contributed to the onset of psychological stress. For example, factors such as travel, warfare, resistance by locals, encountering new environment, diseases, epidemics, diet, captivity, riots, the effect of long working hours, lack of support at work, pressure at work, job insecurity and famine (Great Famine of 1315-1322), and the Black Death may all have led to psychological stress and ill health. The constructive influence of religion and positive stimuli on people suffering from psychological stress was also considered. It was determined that there is the possibility that in the past these kinds of stimuli were present.

An alternative hypothesis to the results was also presented, on the basis that the higher rate of enamel hypoplasia, cribra orbitalia, and tibial periostitis actually indicate good health and a strong defence mechanism. Interestingly, when the actual hypothesis obtained and the alternative hypothesis results were combined and applied, the level of good health was similar for all the periods. However, the evidence (clinical, pathological, psychological, historical and archaeological) that was discussed in this dissertation does not support this hypothesis. It is clear that changes in the rates of dental and skeletal markers of stress occurred over time.

9.2 Limitations of the study

It is important to discuss here the limitations that this study encountered:

- The research has only provided data that indicate a likely frequency of specific dental and skeletal markers of stress in the past, which without doubt is an under-estimation of the real frequency (Wood *et al.*, 1992).
- The number of individuals studied for each period does not represent the whole population that was affected by any of the indicators of stress. It only represents the number of individuals with the condition from the portion of individuals living, buried, preserved and recovered (Waldron, 1994a).
- The multifactorial nature of the causes of stress markers is a problem as the specific aetiological factor that produced a specific marker of insult cannot be assessed (Tuross, 2003).
- The individuality of response to stress: each person will react towards stress in different ways to another person (Selye, 1976).
- The variation in methods used to diagnose skeletal stress markers by different curators makes comparisons between populations difficult (Waldron, 1994a). Conheeney (2000a, 2000b) stated that various osteologists were involved in the recording of skeletal remains at the Romano-British site of the Eastern Cemetery of Roman London.
- Preservation of skeletal material can affect the recording of pathological conditions; for example, Roberts (1984) noted that some bones at the Romano-British site of Baldock 3 were eroded leading to the lost of important information and Waldron (1994b) mentions that several skeletal remains at the Early Medieval site of Great Chesterford, Essex had post-mortem damage to skulls and mandibles. Post-mortem damage to skeletal material can be caused by

plough, drainage works, agriculture machinery, new graves, etc as some of the material from Edix Hill (Malin and Hines, 1998).

- Lack of/or incomplete information in skeletal reports, for example of teeth affected, male and female differences, juvenile data.
- Inconsistency in the data presented for the reports; for example in some cases there were discrepancies between the information in the text and the information in the tables.
- Poor preservation of other archaeological materials, for example plant remains which makes contextualizing the skeletons data impossible.
- Problems with adult age estimation. It was observed in this research that different skeletal reports used different aging techniques, perhaps based on the skeletal element found, but it also could be based on the ability and personal choice of the osteologists.
- Problems of using different skeletal reports written by various bioarchaeologists which introduces inter and intra-observer errors.
- The different ways of presenting data between reports; for example, the skeletal report of the Late Medieval site of Royal Mint, reports that seven individuals had periostitis, but no specific information on the bone affected was given.
- Lack of "context" data for many sites.
- Lack of integration of biological and archaeological data.

A standardization of the recording system used by all bioarchaeologists is needed to allow comparison between populations; fortunately, this is now operational in Britain (Brickley and McKinley, 2004) and should in the future prevent many of the limitations described above. Agreement is however needed between bioarchaeologists to use one recording system, with reviews of the standards undertaken periodically.

Fortunately, despite the limitations, the data produced provided more concrete evidence that people from the Early Medieval period in Britain were healthier than the previous Romano-British and subsequent Late Medieval period. It has introduced new data on tibial periostitis and suggested psychological stress as another factor to be considered when assessing health in the past.

9.3 Prospects for Future Work

Without doubt, more research is needed on psychological stress and its implications for health in the past. Detailed work on tibial periostitis, duration of breastfeeding, weaning and its relation to the incidence of enamel hypoplasia across time is also recommended as the potential of these data could change some of the interpretations in the literature. It is also recommended that, with the data collected in this research, detailed studies be completed in Britain, including information on each dental and skeletal marker of stress, for example, studies on the prevalence of a condition by sex within any of the periods, sites and regions in England. This would benefit comparative studies. Additionally, dental disease studies should include data on which teeth were more affected by dental caries and enamel hypoplasia. The broad scope of this dissertation has limited the specific detail that could be presented. For example, even though the archaeological sites selected were from the southern and eastern region of England, new data, sites and skeletal reports from this area are needed to really understand the development, rates and implications for the markers of stress in this region. More stable isotope identification of migrants in skeletal samples needs to be done which would facilitate the study of migration and its implication for health.

It is also recommended that other stress markers are explored, for example Harris lines, vertebral canal stenosis, dental asymmetry and crowding, traumatic lesions, osteoporosis, nutritional deficiencies (scurvy and rickets), in one region (For example, southern and eastern England) and specifically during the Romano-British, Early and Late Medieval periods to compare the data and correlate the finding of this research with the new data obtained. It will be interesting to see if the data point to the same conclusions.

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Appendices A-E

Appendix A

Original Skeletal Reports considered.

Romano-British

Sites	Authors	No of Individuals
1- Baldock 1, Hertfordshire	McKinley, 1993	190
2- Baldock 3, Herfortshire	Roberts, 1984	145
3- Cirencester, (south)	Wells, 1982	362
4 - Colchester, Essex	Pinter-Bellows, 1993	575
5- London, Eastern Cemetery	Conheeney, 2000	550
6- Winchester, Hampshire	Browne, no date	369
7- Ancaster, Lincolnshire	Cox, 1989	327
8- Trentholme Drive, York, Yorkshire	Warwick et L.,1968	329
9 - Poundbury, Dorset	Farwell and Molleson, 1993	1131

Early medieval/ Anglo-Saxon sites

Sites	Authors	No of Individuals
1- Baldock 1, Hertfordshire	McKinley, 1993	190
2- Baldock 3, Herfortshire	Roberts, 1984	145
3- Cirencester, (south)	Wells, 1982	362
4 - Colchester, Essex	Pinter-Bellows, 1993	575
5- London, Eastern Cemetery	Conheeney, 2000	550
6- Winchester, Hampshire	Browne, no date	369
7- Ancaster, Lincolnshire	Cox, 1989	327
8- Trentholme Drive, York, Yorkshire	Warwick et L.,1968	329
9 - Poundbury, Dorset	Farwell and Molleson, 1993	1131
10- Eccles, Kent	Boocock et al., 1995	166
11- Monkwearmouth, Tyne and Wear	Anderson et al., in press	327
12- North Elmham Park, Norflok	Wells and Cayton, 1980	206
13- Tanner's Row, Pontefract, Yorkshire	Lee, no date	178
14- Raunds, Furnells, Northamptonshire	Powell, 1996	338
15- Nazeingbury, Essex	Puttnam, 1978	150
16- Empingham II, Rutland	Mays, 1996	150
17- Burgh Castle, Norfolk	Anderson & Birkett, 1993	167
18- Bidford-0n-Avon, Warwickshire	Brash, 1923-1924	170

Late Medieval

Sites	Authors	No of Individuals
1- Abingdon Abbey, Oxon	Hacking & Wakeley, no date	589
2- Blackfriars Friary, Ipswich, Suffolk	Mays, 1991; Mays, 1996	250
3- Jewbury, York	Lilley et al.,1994	475
4- St Andrew, Fishergate, York	Stroud & Kemp, 1993; Knusel et al., 1997; Goggel, 1994	402
5- St Helen on the Walls, York, Yorkshire	Dawes & Magilton, 1980	1037
6- St James & St Mary Magdalene, Cichester, Sussex	Lee and Magilton, 1989	351
7- St Mary Graces Priory, London	Waldron, 1993	841
8- St Oswald Priory, Gloucester	Rogers, 1993	487
9- Thetford, Norfolk	Stroud, 1993	149
10- Wharram Percy, Yorkshire	McMullen, 1998; Ortner and Mays, 1998	361/681
11- Blackfriars Street, Carlisle, Cumbria	Henderson, 1990	214
12-Franciscan Church, Hartlepool, Cleveland	Birkett, 1986	150
13- St Gregory's Priory, Canterbury, Kent	Anderson & Carter, 1994	1300
14-St Nicholas Shambles, London	White, 1988	234
15- Taunton Priory, Taunton	Rogers, 1984	162
16- Royal Mint, London	Waldron, 1993	841
17- St Margaret in Combusto, Norwich, Norfolk	Stirland, 1996, 1997	413
18- Mary Rose, Portsmouth, Hampshire	Stirland & Waldron, 1997; Stirland, 2000	179
19- St Augustine the Less, Bristol	O'Connell, 1998	160
20- Hull Priory, Humberside	Boylston *et al.*, 2001	245
21- Stonar, Kent	Eley & Bayley, 1975	153

Appendix B

Archaeological Site Information

Site Name: ____

____

Location: ____

Date: ______________________ Period: ______________________

Site Type: ____

Notes: ____

Date Excavated: __________________ Report by: __________________

____

Environment: ____

Notes/Reference: ____

Number of Individuals

Females: ______________ Subadult: ______________

Males: ______________ Unaged: ______________

Unsexed: ______________

Total Adults: ______________

Minimum Number of Individuals: ______________

Ages Represented:

Notes:

Stress Markers

Stature

	Minimum	Mean	Maximum	Number
Males:	________	______	_________	_______
Females:	________	_______	__________	________

Method Used: ____

Notes:

Dental Disease

No. of Individuals Observed: ___________ No. of Teeth Present: __________

No. of Males Observed: ______________ No. of Male Teeth Present: __________

No. of Females Observed: ______________ No. of Female Teeth Present: __________

Caries Lesions

No. of Individuals with Caries L: _________ No. of Teeth with Caries L: ___________

No. of Males with Caries L: _____________ No. of Male Teeth with Caries L: _______

No. of Females with Caries L: ___________ No. of Female Teeth with Caries L: _____

Notes:

Enamel Hypoplasia

No. of Individuals with EH: __________ No. of Teeth with EH: _______________

No. of Males with EH: ______________ No. of Male Teeth with EH: __________

No. of Females with EH: _____________ No. of Female Teeth with EH: ________

Notes:

Infectious Disease

Non-Specific Infection

No. of individuals with Tibial Periostitis:____________

No. of Males with Tibial Periostitis:___________

No. of Females with Tibial Periostitis:____________

Metabolic Disease

Cribra Orbitalia

No. of individuals with Cribra Orbitalia:____________

No. of Males with Cribra Orbitalia:___________

No. of Females with Cribra Orbitalia:____________

Notes:

Notes:

THEMES

GENERAL NOTES

Appendix C

List of data collected from each report/site (all periods):

-Archaeological Site Information:

*Site Name
*Location
*Easting
*Northing
*Date
*Period
*Site Type
*Notes
*Date Excavated
*Skeletal Report by
*Environment
*Reference and Notes

-Number of Individuals:

*Period
*Males
*Females
*Unsexed
*Total Adults
*Subadult
*Unaged
*Skeletal Sample Size
*Notes

-Mean Age at Death:

*Period
*Male
*Female
*Unsexed
*Juvenile
*Adult Combined
*Total Combined
*Notes

-Male Stature:

*Period
*Minimum Stature
*Mean Stature
*Maximum Stature
*Number of Individuals with Recorded Stature
*Notes

-Female Stature:

*Period
*Minimum Stature
*Mean Stature
*Maximum Stature
*Number of Individuals with Recorded Stature
*Notes

-Dental Disease:

*Period
*Number of Individuals Observed
*Number of Males Observed
*Number of Females Observed
*Number of Unsexed Observed
*Number of Teeth Present
*Number of Male Teeth Present
*Number of Female Teeth Present
*Number of Unsexed Teeth Present
*Number of Juvenile Teeth Present
*Notes

-Dental Caries:

*Period
*Number of Individuals with Dental Caries
*Number of Males with Dental Caries
*Number of Females with Dental Caries
*Number of Adults with Dental Caries
*Number of Juveniles with Dental Caries
*Number of Unsexed Adults with Dental Caries
*Number of Unsexed Adults Teeth with Dental Caries
*Number of Teeth with Dental Caries
*Number of Male Teeth with Dental Caries
*Number of Female Teeth with Dental Caries
*Notes
*Age

-Enamel Hypoplasia:

*Period
*Number of Individuals Observed
*Number of Males Observed
*Number of Females Observed
*Number of Unsexed Adults Observed
*Number of Juveniles Observed
*Number of Individuals with Enamel Hypoplasia
*Number of Males with Enamel Hypoplasia
*Number of Females with Enamel Hypoplasia
*Number of Unsexed Adults with Enamel Hypoplasia
*Number of Juveniles with Enamel Hypoplasia
*Number of Teeth with Enamel Hypoplasia
*Number of Male Teeth with Enamel Hypoplasia
*Number of Female Teeth with Enamel Hypoplasia
*Notes

-Tibial Periostitis:

*Period
*Number of Individuals with Tibial Periostitis
*Number of Males with Tibial Periostitis
*Number of Females with Tibial Periostitis
*Number of Unsexed Adults with Tibial Periostitis
*Number of Juveniles with Tibial Periostitis
*Notes

-Cribra Orbitalia:

*Period
*Number of Males with Cribra Orbitalia
*Number of Females with Cribra Orbitalia
*Number of Children with Cribra Orbitalia
*Number of Unsexed Adults with Cribra Orbitalia
*Number of Adults with Cribra Orbitalia
*Total Number of Individuals with Cribra Orbitalia
*Notes
*Ages

-Psychological Stress:

*General information (this refers to any information obtained in the reports that could be associated with psychological stress, for example, death, psychological effects of pathological conditions, etc.).

Data collected for the period background chapters:

-General environment and climate.

-Living environment: The Rural Setting

-Living environment: The Urban Setting

-Trade.

-Diet and economy.

-Meat
-Cereal, Vegetables and Fruits
-Salt, Herbs and Spices
-Honey and Sugar
-Drinks

-Occupation and social status.

-Access to Health Care.

-Religion and Burial Practices.

Appendix D -Data in Microsoft Excel Sheets
D.1- Archaeological Sites: General Information

Site Name	Location	Easting	Northing	Period	Site Type	Notes	Date Excavated	Skeletal Report by	Environment	Reference and Notes
Baldock 1, Hertfordshire	TL 2500 3400			RB			Late 1980'	Mckinley, 1993		Mckinley, J. (1993) Human skeletal report from Baldock, Hertforshire, Unpublished
Baldock 3, Hertfordshire	TL 2500 3400			RB	4th C AD (Second half) -5th C (early years) -2 burials from the 1st C		1980-1983 & 1985	Roberts, C (1984)		Roberts, C.A (1984) The human skeletal report from Roman Baldock, Hertfordshire, Bradford, Calvin Wells Laboratory, University of Bradford, North Herfordshire District Council Archaeological Services, Unpublished
Colchester, Butt Road, Essex		599500	225500	RB	Late Roman c 320/40 - 400+	Early Urban Society/ Urban Cemetery - Camulodunum	1971-1988	Pinter-Bellows, S (1993)	Urban	Pinter-Bellows, S (1993) The human skeletons, in N.Crummy, P. Crummy and C. Crossan, Excavations of Roman & later cemeteries churches & monastic sites in Colchester, 1971-1988, Colchester, Archaeological Trust, Archaeological Report 9, pp. 62-92
The Eastern Cemetery of Roman London	TTL 85-3365 8140			RB	1C - 5C	Roman civic cemetery - Normal urban population	1983-1990	Conheeney, J (2000)	Urban	Conheeney, J. (2000) The inhumation burials, in B.E.Barber and D. Bowsher, The Eastern Roman cemetery of Roman London excavations 1983-1990, London, Museum of London and English Heritage, Museum of London Archaeological Services Monograph 4:277-296 - Conheeney, J. (2000) The inhumed human bone, in B.E.Barber and D. Bowsher, The Eastern Roman cemetery of Roman London excavations 1983-1990, London, Museum of London and English Heritage, Museum of London Archaeological Services Monograph 4: 355-360

Winchester, Hampshire	SU 484 291	448500	129500	RB	3rd - 4th C	sample from 3 cemeteries		Browne, no date		Browne, S. no date. The Third and Fourth Century burials from Winchester, umpublished skeletal report
Great Chesterford, Essex	TL 501435	550100	243500	EM	EM 5-7th C A.D	Pagan Saxon Cemetery - Most graves 6th C.	1950's(1953-1955)	Evison, V - Skeletal Report by Tony Waldron		Evison, V. (1994) An Anglo Saxon Cemetery at Great Chesterford, Essex, CBA Research Report 91, Council for British Archaeology. Waldron, T.(1994) The human Remains in V.Evison (ed), An Anglo-Saxon Cemetery at Great Chesterford, Essex, CBA Research Report 91, Council for British Archaeology, pp. 52-56 Serjeantson, D. (1994) The animal bones in Evison (ed) An Anglo-Saxon Cemetery at Great Chesterford, Essex, CBA Research Report 91, Council for British Archaeology, pp. 52-56
Wicken Bonhunt, Essex	TL 499 331			EM		Occupation ceased at the end of the Middle Saxon period	1968-1969 by Bari Hooper - 1970- 1974 by Keith Wade	Hooper, B (?) Report on the Human Remains at Bonhunt 1968- 1974. Unpublished.		Hooper, B (?) Report on the Human Remains at Bonhunt 1968- 1974. Unpublished.
Nazeingbury, Essex	TL 386 066	538600	206600	EM	Middle Saxon -7th-9th C	Early Christian -Possible a nunnery hospital	1975-1976	Puttnam, G (1978)	Rural	Puttnam, G. (1978) Analysis of the skeletal material, in P.G. Huggins, Excavation of a Belgic and Romano-British farm with Middle Saxon cemetery and churches at Nazeingbury, Essex, 1975-6, Essex Archaeology 10:54-67

Buckland, Dover, Kent	TR 310430	631000	143000	EM	EM 5th-7th C A.D		1950's(1951-1953)	Evison, V - Skeletal Report by Rosemary Powers & Rachel Cullen		Evison, V. (1987) Dover: Buckland Anglo-Saxon Cemetery, London, Historic Buildings and Monuments Commission for England Archaeological Report 3 Powers, R and Cullen, R. (1987) The Human Skeletal Remains in Evison, V. (1987) Dover: Buckland Anglo-Saxon Cemetery, London, Historic Buildings and Monuments Commission for England Archaeological Report 3
Eccles, Kent		572200	160500	EM	Middle Saxon-7th C	A lot of discrepancies b/w text & tables	1970-1974	Boocock, P., Manchester, K. and Roberts, CA (1995)		Boocock, P., Manchester, K. and Roberts, CA (1995) The human remains from Eccles, Kent, Bradford, Calvin Wells Laboratory, University of Bradford, Unpublished
Staunch Meadow, Brandon, Suffolk	TL 7790 8656			EM	Middle Saxon	Cemetery 1 analised -158 Individuals		Anderson, S		Anderson, S (1990) The Human Skeletal Remains From Staunch Meadow, Brandon, Suffolk. Ancient Monuments Laboratory Report 99/90. Historic Buildings and Monuments Commission for England.
Edix Hill, Barrington, Cambrigeshire		539500	249500	EM	EM 5th-7th C A.D	Pagan Saxon Cemetery	1987- 1991	Duhig, C (1998)		Duhig, C. 1998. The human skeketal material, in T. Malin and J. Hines, The Anglo-Saxon cemetery at Edix Hill (Barrington A), Cambridgeshire, York, Council for British Archaeology Research Report 112, pp. 154- 199
North Elmham Park, Norfolk		598700	321500	EM	Late Saxon 10th-11th C	Cathedral Cemetery, Early Christian	1967-1972	Wells, C. and Cayton, H 1980	Rural	Wells, C and Cayton, H (1980) The human bones, in P. Wade-Martins, Excavations at North Elmham Park 1967-1972, Norwich, Museums Service, Norfolk Archaeological Unit, East Anglian Archaeology 9, pp.247-374

Burgh Castle, Norfolk	TG 474045	647400	304500	EM	Middle Saxon -7th-10th C	Secular site - Christian cemetery	1958-1961	Anderson, S & Birkett, D		Anderson, S and Birkett, A (1993) The human skeletal remains from Burgh Castle, in M. Darling and D. Gurney, Caister-on-Sea. Excavations by Charles Green 1951- 1955, East Anglian Archaeology Report, Field Achaeology Division, Norfolk Museums Service 60: 256- 260
Blackfriars Friary, Ipswich, Suffolk		616500	244500	LM	13th - 16th C	Dominican - SK interred b/w 1263 - 1538	1983 - 1985	Mays, Simon (1989 & 1991)		Mays, S. (1989) The Anglo-Saxon human bone report from School Street, Ipswich, Suffolk, English Heritage Ancient Monuments Laboratory Report 115/89, Unpublished -Mays, S.(1991) The medieval burials from the Blackfriars Friary, School Street, Ipswich, Suffolk, English Heritage Ancient Monuments, Laboratory Report, 16/91, part 1, unpublished
St James and St Mary Magdalene Hospital, Chichester, Sussex		486500	104500	LM	12th - 17th C	Leprosy Hospital - odd site	1986 - 1987 & 1992	Magilton & Lee	Urban	Lee, F. and Magilton, J. 1989. The cemetery of the hospital St James and St Mary Magdalene, Chichester - a case study, World Archaeology 21: 2, 273 - 282 -Magilton, J and Lee, F. (1989) The cemetery of the hospital of St James and St Mary Magdalene, Chichester: a case study, World Archaeology 21:273 - 282

Royal Mint, St Mary Graces Priory, London	TQ 339 807	533900	180700	LM	14th - 16th C	Pre-reformation Christian Black Death cemetery & Cistercian Monks -Black Death 1348 - 1350 -includes church burials and some plague burials, info in recording form	1986 - 1988	Waldron, 1993		Waldron, H. (1993) The human remains from the Royal Mint site (MIN86), London, Museum of London Archive Report HUM/07/93, Unpublished Report - Grainger, I., Hawkins, D., Falcini, P. and Mills, P. (1988) Excavation at the Royal Mint site 1986 - 1988, The London Archaeologist 5: 429 -436 -Hawkins, D. (1990) The Black Death and the new London cemeteries of 1348, Antiquity 64: 637- 642
St. Nicholas Shambles, London	TQ 32050 81350			LM	11th -12th C	Pre-Reformation Christian - Church cemetery - close-knit christian society	1975 - 1977	White, William (1988)		White, W. (1988) The cemetery of St Nicholas Shambles, London, London and Middlesex Archaeological Society
Spitalfields Market, London	Q33450 81950	533450	181950	LM	12th - 16th C	Hospital & Priory -same site as St Mary Spital - Founded 1197 -Dissolution 1538	1998 - 2001	Brian Connell, 2002		Connell, B. (2002) The cemetery population from Spitalfields Market London: An Osteological Pilot Study and Post-excavation assessment. Museum of London Archaeological Service (MoLSS), London: Unpublished -Conheeney, J. (1997) the human bone, in excavations at the Hospital of St. Mary Spital, London, C Thomas, B Sloane and C Phillpotts, Museum of London Archaeological Service (MoLSS) Monograph 1

Thetford, Norfolk	TL 8705 8231	587050	282310	LM	11th -12th C	Early Late medieval	1964 - 1970 -church cemetery excavated 1969 - 1970	Stroud, G (1993)		Stroud, G. (1993) Human skeletal material, in Dallas, C. Excavations in Thetford by B.K. Davison between 1964-1970, Norfolk, Norwih, Museums Service, Field Archaeology Division, Norfolk Archaeological Unit, East Anglian Archaeology 62: 168 -176
Stratford Langthorne Abbey, Essex	TQ 39020 83400	539020	183400	LM	12th - 16th C	Cistercian monastery dated 1135-1538	1983 -Sept - Dec	Stuart-Macadam, P (1985, 1986) -White, B (1999)	Urban	White, B (1999) Human skeletal remains from St. Mary. Stratford Langthorne, Museum of London Archaeological Services (MOLSS), London: Unpublished Report -Stuart-Macadam, P (1985) The report on the Stratford Langthorne skeletal collection, Bradford, Calvin Wells Laboratory, University of Bradford, unpublished -Stuart-Macadam, P (1986) Health and Disease in the monks of Stratford Langthorne Abbey. Essex Journal 21:67-71

D.2- Number of Individuals

Site Name	Period	Males	Females	Unsexed	Total Adults	Subadult	Unaged	Skeletal Sample Size	Notes
Baldock 1, Hertfordshire	RB	74	50	5	129	62		191	Number of individuals includes people from all 3 areas of the site
Baldock 3, Hertfordshire	RB	45	63	21	129	15		144	
Colchester, Butt Road, Essex	RB	170	140	157	467	108		575	
The Eastern Cemetery of Roman London	RB	186	109	88	383	129		512	
Winchester, Hampshire	RB	103	76	42	221	144	10	375	Total includes 10 cremations
Great Chesterford, Essex	EM	35	43	89				167	
Wicken Bonhunt, Essex	EM	94	59	13	166	56		222	Juveniles (up to 16 years)
Nazeingbury, Essex	EM	34	88	15	137	17		154	Adult start age 17
Buckland, Dover, Kent	EM	54	66		120	42		162	
Eccles, Kent	EM	72	61		133	36		169	Adult start age 17
Staunch Meadow, Brandon, Suffolk	EM	57	41	25	123	35		158	Number of individuals from cemetery 1
Edix Hill, Barrington, Cambrigeshire	EM	48	40	14	102	46		148	
North Elmham Park, Norfolk	EM	82	76	9	167	39		206	Adult start age 18
Burgh Castle, Norfolk	EM	79	64	24	167	30		197	The number of subadults is approximate
Blackfriars Friary, Ipswich, Suffolk	LM	148	64	14	226	24		250	
St James and St Mary Magdalene Hospital, Chichester, Sussex	LM	191	75	18	284	100		384	Sample total vary b/w total given in BAR (351) and number calculated.
Royal Mint, St Mary Graces Priory, London	LM	376	249	63	688	244	2	934	
St. Nicholas Shambles, London	LM	90	71	19	180			234	
Spitalfields Market, London	LM	83	76	9	168	32		200	Adult start age 18 -Two groups selected:Normal cemetery 100 individuals -Mass pits: 100 individuals
Thetford, Norfolk	LM	19	21	47	87	59	3	149	Pop info from microfiche -Adult start age 20
Stratford Langthorne Abbey, Essex	LM	536	28	55	619	28		647	Bill White data considered; it is looked upon as a single population

D.3- Mean Age at Death

Site Name	Period	Male	Female	Unsexed	Juvenile	Adult Combined	Total Combined	Notes
Baldock 1, Hertfordshire	RB	26 - 45	26 - 45					
Baldock 3, Hertfordshire	RB					28.6±5		
Colchester, Butt Road, Essex	RB	37.8±5	35.5±5		6.4±2.5	36±5		
The Eastern Cemetery of Roman London	RB					26.5±5		
Winchester, Hampshire	RB				4.6±2	28.9±5		
Great Chesterford, Essex	EM	31	30			30		
Wicken Bonhunt, Essex	EM	35.2	33.5		5.3	34.7		
Nazeingbury, Essex	EM				7± 1.5	36± 5		
Buckland, Dover, Kent	EM	36+	31+		5+	31		
Eccles, Kent	EM	32±5	33±5		8±2	32±5		
Staunch Meadow, Brandon, Suffolk	EM	35 ± 5	34± 5	34± 5	8± 2	34± 5	31± 5	
Edix Hill, Barrington, Cambrigeshire	EM	32±2.5	31±2.5		8±1	31±2.5		
North Elmham Park, Norfolk	EM				6.6	37		Higher than other sites, better health??
Burgh Castle, Norfolk	EM	31.5±5	39±5		9± 3	35± 5		
Blackfriars Friary, Ipswich, Suffolk	LM	40.5	41.5			40.8		
St James and St Mary Magdalene Hospital, Chichester, Sussex	LM							
Royal Mint, St Mary Graces Priory, London	LM				7.4±2	36±5		
St. Nicholas Shambles, London	LM					30		Figure low by comparison with other sites
Spitalfields Market, London	LM				10.6± 2.5	33± 4.5		
Thetford, Norfolk	LM	38± 5	37± 5		6± 3	37± 5		
Stratford Langthorne Abbey, Essex	LM	35±5	37±5		14±2	35±5		

D.4- Male Stature

Site Name	Period	Minimum	Mean	Maximum	Number	Notes
Baldock 1, Hertfordshire	1 RB	1.51	1.69	1.81	68	
Baldock 3, Hertfordshire	2 RB	1.6	1.67	1.75	23	
Colchester, Butt Road, Essex	3 RB	1.54	1.68	1.9	85	
The Eastern Cemetery of Roman London	4 RB	1.58	1.69	1.8	104	
Winchester, Hampshire	5 RB	1.53	1.68	1.79	79	
Great Chesterford, Essex	EM	1.51	1.66	1.83	28	
Wicken Bonhunt, Essex	EM	1.56	1.72	1.83	70	
Nazeingbury, Essex	EM	1.7	1.75	1.81	11	
Buckland, Dover, Kent	EM	1.69	1.74	1.71	6	
Eccles, Kent	EM	1.62	1.72	1.92	55	One individual was 1.92
Staunch Meadow, Brandon, Suffolk	EM	1.6	1.71	1.86	24	
Edix Hill, Barrington, Cambrigeshire	EM	1.6	1.73	1.84	35	
North Elmham Park, Norfolk	EM	1.62	1.72	1.8	45	
Burgh Castle, Norfolk	EM	1.65	1.75	1.86	54	
Blackfriars Friary, Ipswich, Suffolk	LM	1.62	1.72	1.85	131	
St James and St Mary Magdalene Hospital, Chichester, Sussex	LM	1.55	1.7	1.9	165	
Royal Mint, St Mary Graces Priory, London	LM	1.49	1.68	1.87	196	
St. Nicholas Shambles, London	LM	1.59	1.72	1.87		Male and Female: 94 individuals
Spitalfields Market, London	LM	1.58	1.7	1.83	62	
Thetford, Norfolk	LM	1.63	1.7	1.82	18	
Stratford Langthorne Abbey, Essex	LM	1.57	1.73	1.84	221	

D.5- Female Stature

Site Name	Period	Minimum	Mean	Maximum	Number	Notes
Baldock 1, Hertfordshire	RB	1.5	1.57	1.68	43	
Baldock 3, Hertfordshire	RB	1.51	1.58	1.68	15	
Colchester, Butt Road, Essex	RB	1.41	1.56	1.71	59	
The Eastern Cemetery of Roman London	RB	1.45	1.58	1.72	75	
Winchester, Hampshire	RB	1.46	1.58	1.74	57	
Great Chesterford, Essex	EM	1.46	1.61	1.71	38	
Wicken Bonhunt, Essex	EM	1.49	1.62	1.77	34	
Nazeingbury, Essex	EM	1.58	1.68	1.74	13	
Buckland, Dover, Kent	EM	1.61	1.66	1.71	8	
Eccles, Kent	EM	1.48	1.62	1.78	46	One individual was 1.78
Staunch Meadow, Brandon, Suffolk	EM	1.47	1.61	1.77	15	
Edix Hill, Barrington, Cambrigeshire	EM	1.51	1.63	1.71	30	
North Elmham Park, Norfolk	EM	1.42	1.57	1.69	39	
Burgh Castle, Norfolk	EM	1.51	1.63	1.76	38	
Blackfriars Friary, Ipswich, Suffolk	LM	1.46	1.61	1.76	58	
St James and St Mary Magdalene Hospital, Chichester, Sussex	LM	1.52	1.59	1.69	70	
Royal Mint, St Mary Graces Priory, London	LM	1.45	1.59	1.77	112	
St. Nicholas Shambles, London	LM	1.5	1.57	1.73		Male & Female: 94 individuals
Spitalfields Market, London	LM	1.43	1.59	1.7	58	
Thetford, Norfolk	LM	1.45	1.58	1.67	19	
Stratford Langthorne Abbey, Essex	LM	1.57	1.59	1.62	5	

D.6- Dental Disease

Site Name	Period	Number of Individuals Observed	Males	Females	Number of Teeth Present	Number of Male Teeth	Number of Female Teeth	Number of Unsexed Teeth	Number of Unsexed Observed	Number of Juvenile Teeth	Notes
Baldock 1, Hertfordshire	1 RB				2806						
Baldock 3, Hertfordshire	2 RB				1533	580	438				
Colchester, Butt Road, Essex	3 RB		85	74	3665	1758	1519				
The Eastern Cemetery of Roman London	4 RB				2031						
Winchester, Hampshire	5 RB				2448						Only individuals over 15 years of age were recorded
Great Chesterford, Essex	EM	84	12	23	1751						
Wicken Bonhunt, Essex	EM	123	71	46	2190				6		
Nazeingbury, Essex	EM										
Buckland, Dover, Kent	EM	60			1581						
Eccles, Kent	EM				1424						
Staunch Meadow, Brandon, Suffolk	EM		64	55	2040	906	717	417			
Edix Hill, Barrington, Cambrigeshire	EM				1600						
North Elmham Park, Norfolk	EM				1819	778	799			242	
Burgh Castle, Norfolk	EM		49	32	1347	793	554				
Blackfriars Friary, Ipswich, Suffolk	LM										
St James and St Mary Magdalene Hospital, Chichester, Sussex	LM	304	166	74	4344	2826	1076			442	
Royal Mint, St Mary Graces Priory, London	LM										189 SK had D Disease (DC, Abscesses & tooth loss or combination of all 3 -Dental pathlogy not done
St. Nicholas Shambles, London	LM										
Spitalfields Market, London	LM										
Thetford, Norfolk	LM	62			1286						36 Adults + 26 subadults observed
Stratford Langthorne Abbey, Essex	LM					7106					

D.7- Dental Caries

Site Name	Period	Number of Individuals with DC	Number of Males with DC	Number of Females with DC	Number of Adults with DC	Number of Juveniles with DC	Number of Unsexed Adults with DC	Number of Unsexed Adults teeth with DC	Number of Teeth with DC	Number of Male Teeth with DC	Number of Female Teeth with DC	Notes	Age
Baldock 1, Hertfordshire	1 RB								296				
Baldock 3, Hertfordshire	2 RB	42	19	18	42		5		102	45	37		
Colchester, Butt Road, Essex	3 RB		3.80%	3.90%					217	157	60	Male:157/1758 teeth with DC - Female:60/1519 teeth with DC	
The Eastern Cemetery of Roman London	4 RB	168	8.50%	8.20%					7.3%/2031teeth present				
Winchester, Hampshire	5 RB	65							160			65/139 (47%) individuals -160/2448 teeth with DC	
Great Chesterford, Essex	EM	15	4	11									
Wicken Bonhunt, Essex	EM	47	31	16					96	65	31	At bonhunt only 4.4% of the teeth are affected by DC.	
Nazeingbury, Essex	EM	10	5	4	9	1							
Buckland, Dover, Kent	EM	19			17	2			67				Juveniles (5 & 8 years old)
Eccles, Kent	EM								82	37	45	82/1424 teeth with DC - 37/771 male teeth - 45/653 female teeth - Combined frequency 5.8%	
Staunch Meadow, Brandon, Suffolk	EM	19	8	6		2	3	4	21	6	11		

Edix Hill, Barrington, Cambrigeshire	EM								51			Males with DC: 20.9% prevalence -Females with DC: 43.2% -Nondetermined sex: 25.0% -Average:30.9% -% of DC is 3.2%	
North Elmham Park, Norfolk	EM		24	21	45				102	53	49	Male: 24/50 individuals with DC -Females: 21/61 individuals with DC	
Burgh Castle, Norfolk	EM	19	14	5	19				25	18	7		
Blackfriars Friary, Ipswich, Suffolk	LM		76	40	116				301	202	99	Male: 76/115 individuals with DC -Female: 40/51 individuals with DC -Male: 202/2039 teeth present -99/854 teeth present	
St James and St Mary Magdalene Hospital, Chichester, Sussex	LM	201	123	54	177	24			684	420	227	Male:123/166 individuals with DC -Female: 54/74 ind with DC -24/59 Juveniles -Teeth:684/4344 -for male & female data see form	
Royal Mint, St Mary Graces Priory, London	LM												
St. Nicholas Shambles, London	LM	35	16	19	35				67	31	36	67/790 teeth present with DC -info from catalogue	
Spitalfields Market, London	LM		45	45	95				291	121	152	95/140 individuals with DC -291/3159 teeth with DC	
Thetford, Norfolk	LM	24	9	7	18	6	2		78			78/1286 teeth present with DC	
Stratford Langthorne Abbey, Essex	LM									288		Info only available for males	

D.8- Enamel Hypoplasia

Site Name	Period	Number of Individuals Observed	No of males Observed	Number of Females Observed	Number of Unsexed Adults Observed	Number of Juveniles Observed	Number of Individuals with EH	Number of Males with EH	Number of Females with EH	Number of Unsexed Adults with EH	Number of Juveniles with EH	Number of Teeth with EH	Number of Male Teeth with EH	Number of Female Teeth with EH	Notes
Baldock 1, Hertfordshire	RB				2		12	7	3						
Baldock 3, Hertfordshire	RB						33	15	11	7		79			
Colchester, Butt Road, Essex	RB						64	25	24	2	13				
The Eastern Cemetery of Roman London	RB						295	8.50%	11.00%					11.9%/2031 teeth present	
Winchester, Hampshire	RB	120					27								27/120 (22%) individuals with EH
Great Chesterford, Essex	EM														
Wicken Bonhunt, Essex	EM														
Nazeingbury, Essex	EM						21	2	2		17				
Buckland, Dover, Kent	EM														Dental enamel too eroded to show surface morphology, Powers & Cullum, 1987 p. 197
Eccles, Kent	EM		43	36			43	24	19						43/ 79 dentitions -Combined frequency: 54.4% -Mistake in figs for males & females (exchanged)
Staunch Meadow, Brandon, Suffolk	EM	95	38	28	14	15	57	28	16	6	7				

Edix Hill, Barrington, Cambrigeshire	EM	115					16	9	5		2	81			81/1600 teeth with EH 4.0%
North Elmham Park, Norfolk	EM	131	50	61		20	42	22	17		3	240	139	101	42/131 individuals with EH -Info from SK catalogue -240/1577 teeth observed.
Burgh Castle, Norfolk	EM							35	20						
Blackfriars Friary, Ipswich, Suffolk	LM	148	92	42		14	53	36	11		6				53/148 individuals with EH -Male:36/92 with EH -Female:11/42 with EH -Juveniles:6/14 with EH
St James and St Mary Magdalene Hospital, Chichester, Sussex	LM	304	166	74			208	120	53			1333	860	281	Male: 120/166 ind with EH -Female: 53/74 ind with EH -Teeth: 1333/4344
Royal Mint, St Mary Graces Priory, London	LM														
St. Nicholas Shambles, London	LM														No number given in the catalogue -high incidence of EH (no numbers)
Spitalfields Market, London	LM	140					81					549			81/140 Adult individuals with EH -549/3159 Adult teeth with EH
Thetford, Norfolk	LM	64					19								19/64 individuals with EH -not explained who?adults?subadults? -poor condition of teeth
Stratford Langthorne Abbey, Essex	LM														1/3 of the individuals with intact dentition showed EH

D.9- Tibial Periostitis

Site Name	Period	Number of Individuals with TP	Number of Males with TP	Number of Females with TP	Number of Unsexed with TP	Number of Juveniles with TP	Notes
Baldock 1, Hertfordshire	RB	12	8	3		1	
Baldock 3, Hertfordshire	RB	8	3	2	3		
Colchester, Butt Road, Essex	RB	7	6	1			Read form
The Eastern Cemetery of Roman London	RB						Data is not clear, not differentiation in the kind of periostitis
Winchester, Hampshire	RB						
Great Chesterford, Essex	EM	1	1				The male is around 15- 20 years of age
Wicken Bonhunt, Essex	EM	19	13	3	3		16% of all tibiae available have TP
Nazeingbury, Essex	EM						
Buckland, Dover, Kent	EM						
Eccles, Kent	EM						Males: 26/104 tibiae -Females: 16/73 tibiae
Staunch Meadow, Brandon, Suffolk	EM	16	7	7	2		
Edix Hill, Barrington, Cambrigeshire	EM	5	2	3			Ages in the recording form
North Elmham Park, Norfolk	EM	10	8	1	1		
Burgh Castle, Norfolk	EM	12	4	4	4		Info from catalogue
Blackfriars Friary, Ipswich, Suffolk	LM	27					27/32 individuals with TP -13.2% in lower legs
St James and St Mary Magdalene Hospital, Chichester, Sussex	LM	128					
Royal Mint, St Mary Graces Priory, London	LM						
St. Nicholas Shambles, London	LM						Large numbers?? Not numbers given in catalogue
Spitalfields Market, London	LM	18					Mostly in the form of striations of woven or lamellar bone parallel to the long axis, in tibia and fibula
Thetford, Norfolk	LM	4	3	1			Info from microfiche -poor perservation of bone
Stratford Langthorne Abbey, Essex	LM						1/3 of lower legs with periostitis -Male showed severe periostitis of both tibiae

D.10- Cribra Orbitalia

Site Name	Period	Number of Males with CO	Number of Females with CO	Number of Children with CO	Number of Unsexed Adults with CO	Number of Adults with C.O	Total of Individuals with C.O	Notes	Ages
Baldock 1, Hertfordshire	RB	15	12		4		31		
Baldock 3, Hertfordshire	RB	7	8		3		18		
Colchester, Butt Road, Essex	RB	6	9	9	5		29	Data differs b/w catalogue and text -catalogue info used	
The Eastern Cemetery of Roman London	RB						Less than 5% of sample affected		
Winchester, Hampshire	RB						28	28/110 (25%) individuals with C.O	
Great Chesterford, Essex	EM		1	3			4	All had bilateral C.O	1 neonate -2 juveniles (6-8 and 8-10) - 1female (25-35)
Wicken Bonhunt, Essex	EM	9	5	7	2		23	23/147 skulls observed	
Nazeingbury, Essex	EM	3	1				4		
Buckland, Dover, Kent	EM								Disguised by erotion p. 198 Powers & Cullen, 1987
Eccles, Kent	EM	4	1	1			6	6/68 skulls observed: 8.8%	
Staunch Meadow, Brandon, Suffolk	EM	6	5	4	2		17	Table on Report not easy to understand	
Edix Hill, Barrington, Cambrigeshire	EM	4	4	7			15	15/82 available sample	
North Elmham Park, Norfolk	EM	1	3	1			5		
Burgh Castle, Norfolk	EM	2	2				4	Info from catalogue	
Blackfriars Friary, Ipswich, Suffolk	LM	28	9	4			41	Male: 28/113 individuals with C.O -Female: 9/48 - Juvenile:4/17 -Total: 41/178	
St James and St Mary Magdalene Hospital, Chichester, Sussex	LM						81	81/303 ind with C.O	
Royal Mint, St Mary Graces Priory, London	LM	6	10	16	2		34		

St. Nicholas Shambles, London	LM	9	7		4		20	Info from catalogue	
Spitalfields Market, London	LM			11		23	34		
Thetford, Norfolk	LM	2		13			15		
Stratford Langthorne Abbey, Essex	LM						22	22/117 individuals with C.O	

Appendix E

List of analytical methods used for each skeletal report

The list presented here is organised by period and by respective skeletal report. It is important to note the difference in the methods used by the various skeletal reports. In some reports there are good descriptions of the methods, while others only give a vague (or no) descriptions at all of the methodology used.

Romano-British Period:

Baldock I, Hertfordshire (McKinley, 1993)

-Age:

-Juveniles:
- -Tooth development and eruption (Van Beek, 1993)
- -Stage of ossification and epiphyseal fusion (Gray, 1977; McMinn and Hutchings, 1985).
- -Length of long bones (Bass, 1987).

-Adults:
- -Degenerative changes in the pubic symphysis (Brooks, 1955).
- -Tooth wear patterns (Brothwell, 1972).
- -Cranial sutures
- -Degenerative changes to the bone.
- -McMinn and Hutchings, 1985.

-Sex:

- -Sexually dimorphic traits (Bass, 1987).
- -Skull vault thickness (Gejvall, 1981).

-Enamel Hypoplasia:

- -Hillson (1979).

-Stature:

- -Trotter and Gleser (1952, 1958).

Baldock III, Hertfordshire (Roberts, 1984)

-Age:

- -Epiphyseal union and dental development (Bass, 1971).
- -Attrition of the molar teeth (Brothwell, 1981).
- -Pubic Symphyseal changes (McKern and Stewart, 1957; Gilbert and McKern, 1973; Katz and Suchey, 1986).
- -Auricular surface of the ilium (Lovejoy *et al.*, 1985).
- -Sternal ends of the ribs (Iscan *et al.*, 1984, 1985).
- -Presence of degenerative joint disease.

-Sex:

-Skull and pelvic morphology (Bass, 1971).
-Humeral head (Dwight, 1905).
-Femur head and bicondylar width (Pearson and Bell, 1919).

-Stature:

-Trotter (1970).

Colchester, Butt Road, Essex (Pinter-Bellows, 1993)

-Stature:

-Trotter (1970).

-Cribra Orbitalia

-Stuart-Macadam (1985a).

The Eastern Cemetery of Roman London (Conheeney, 2000a, 2000b)

-Age:

-Juveniles: -Dental development (Ubelaker, 1989).
-Diaphysis length (Ubelaker, 1989).
-Epiphyses (Bass, 1987).

-Adult: -Dental Attrition (Brothwell, 1981).
-Cranial sutures (Meindl and Lovejoy, 1985).
-Pubic symphysis degeneration (Suchey *et al.*, 1986, 1988).

-Sex:

-Sexual dimorphic features on the skull and pelvis (Ferembach *et al.,* 1980; Brothwell, 1981; Bass, 1987).
-Measurements of femur, humerus, atlas, scapula, clavicle and sacrum (Ferembach *et al.,* 1980; Brothwell, 1981; Bass, 1987).

-Stature:

-Trotter and Gleser (1952, 1958).

Winchester Hampshire (Browne, no date)

-Methods:

- Brothwell (1981).

Early Medieval period:

Great Chesterford, Essex (Evison, 1994; Waldron, 1994b)

-Age:

-Juveniles: -Tooth eruption
-Epiphyseal fusion
-Measurements of the diaphysis of long bones (Fazekas and Kosa (1978).
-For foetuses and infants (Maresh, (1955).

-Adult: -Tooth wear (Miles, 1963).
-Pubic symphysis
-Cranial suture fusion.

-Sex:

-Workshop of European Anthropologists (1980).
-Krogman and Iscan (1986).
-Pelvic and skull characteristics.

-Stature:

-Trotter (1970).

-Cribra Orbitalia:

- Stuart- Macadam (1985).

Wicken Bonhunt, Essex (Hooper, no date)

-Age:

-Juveniles: -State of development of the dentition.
-Degree and pattern of ossification (Krogman, 1946).

-Adult: -Age changes in the bones (Krogman, 1946).
-Age changes in the dentition (Gustafson, 1950).
-Dental attrition (Brothwell, 1963).
-Pubic symphysis (McKern and Stewart, 1957).
-General bone degeneration.

-Sex:

-Skull, pelvis, sacrum, clavicle, sternum, long bone length (Krogman, 1946).

-Stature:

-Trotter and Gleser (1952).

-Cribra Orbitalia:

-Nathan and Hass (1966).

Buckland, Dover, Kent (Evison, 1987; Powers and Cullen, 1987)

– Methods used none specified in the skeletal report.

Staunch Meadow, Brandon, Suffolk (Anderson, 1990)

- Age:

-Brothwell (1981).
-Workshop of European Anthropologists (1980).
-Attrition (Bouts and Pot, 1989).

- Sex:

-Brothwell (1981).
-Workshop of European Anthropologists (1980).
-Sciatic notch angle (Dawes and Magilton, 1980).

-Other measurements: Bass (1971).
Krogman(1978).

-Stature:

-Trotter and Gleser (1970).

-Enamel Hypoplasia:

- Scored on a four point scale.

Nazeingbury, Essex (Putnam, 1978)

-Age:

- Epiphyseal fusion.
- Suture closure.
-Vallois (1937).
-Brothwell (1971).

-Sex:

-Krogman (1946).
-Keen (1950).
-Brothwell (1971).

-Stature:

-Trotter and Gleser (1970).

-Dental Caries:

- Moore and Corbett (1971).

North Elmham Park, Norfolk (Wells and Cayton, 1980)

-Age:

-Juveniles: -Teeth
-Epiphyses

-Adult: -Pubic symphysis
-Attrition

-Sex:

-Sexual dimorphism (pelvis, skull and clavicles).

-Stature:

-Trotter and Gleser (1958) for males.
-Trotter and Gleser (1952) for females.

Edix Hill, Barrington, Cambridgeshire (Duhig, 1998)

-Age:

-Ubelaker (1989).
-Tooth wear (Moorees *et al.*, 1963).
- Cranial sutures (Meindl and Lovejoy, 1985).
-Pubic symphysis (Brooks and Suchey, 1990).
-Auricular surface (Lovejoy *et al.*, 1985).
-Brothwell (1981)

-Sex:

-Sex from the os pubis (Phenice, 1969).
-Ubelaker (1989).
-Brothwell (1981).
- Cranial morphology (Stewart, 1979).

-Stature:

-Trotter (1970).

-Cribra Orbitalia:

-Stuart-Macadam (1989).

Burgh Castle, Norfolk (Anderson and Birkett, 1991, 1993)

-Age:

-Dental attrition (Brothwell, 1981).
-Workshop of European Anthropologists (1980).

-Sex:

-Brothwell (1981).
-Workshop of European Anthropologists (1980).
-Sciatic Notch Angle (Dawes and Magilton, 1980).

-Stature:

-Trotter and Gleser (1970).

Eccles, Kent (Boocock *et al.*, 1995)

-Age:

-Juveniles: -Epiphyseal fusion (Brothwell, 1981).
-Dental eruption and development (Moorees *et al.*, 1963; Ubelaker, 1989).
-Diaphyseal length (Hoppa, 1992).
-Foetal diaphyseal length (Scheuer *et al.*, 1980).

-Adult: -Dental attrition (Brothwell, 1981).
-Pubic symphysis (McKern and Stewart, 1957; Brooks and Suchey, 1990; Katz and Suchey, 1986).
-Auricular surface.

-Sex:

-Skull and Pelvis (Bass, 1987; Phenice, 1969).
-Measurements of femoral head and condyles, humeral head, sternum and clavicle (Stewart, 1979).

-Stature:

-Trotter (1970).

Late Medieval period:

Blackfriars Friary (Mays, 1991)

-Age:

-Dental development (Ubelaker, 1978).
-Long bone length (Scheuer *at al.*, 1980).
-Epiphyseal fusion (Workshop of European Anthropologist, 1980).
-Dental attrition (Brothwell, 1981).
-Cranial sutures (Perizonius, 1984).
-Pubic symphysis (Suchey and Brooks, 1986; Suchey *et al.*, 1988).

-Sex:

-Pelvis and skull.

-Stature:

-Trotter and Gleser (1952, 1958).

-Cribra Orbitalia:

-Brothwell (1981).

St. James and St. Mary Magdalene Hospital, Chichester, Sussex (Lee and Magilton, 1989; Magilton and Lee, 1989)

-Stature:

-Trotter (1970).

Royal Mint, St. Mary Graces Priory, London (Waldron, 1993)

-Age:

- Standard anthropological techniques.

-Stature:

-Trotter (1970).

Spitalfields Market, London (Connell, 2002; Conheeney, 1997)

-Age:

-Juveniles: -Length of long bone diaphysis (Maresh, 1970; Fazekas and Kósa, 1978; Scheuer et al., 1980).
-Dental development (Moorees *et al.*, 1963; Smith, 1991).
-Epiphyseal fusion (Scheuer and Black, 2000).
-Tooth eruption (Ferembach et al., 1980).

-Adult: - Pubic symphysis (Brooks and Suchey, 1990).
- Auricular surface (Lovejoy *et al.*, 1985).
- Changes at the costo-chondral junction (Iscan *et al.,* 1984, 1985).
- Molar wear (Brothwell, 1981).

-Sex:

-Pelvis and skull morphology (Phenice, 1969; Ferembach *et al.*, 1980; Buikstra and Ubelaker, 1994).

-Stature:

-Trotter (1970).

-Cribra Orbitalia:

-Stuart-Macadam (1991).

St. Nicholas Shambles, London (White, 1988)

-Age:

-Brothwell and Higgs (1965).
-Ubelaker (1978).
-Workshop of European Anthropologists (1980).
-Brothwell (1981).

-Sex:

-Brothwell (1981).

-Stature:

-Trotter and Gleser (1952, 1958).

Thetford, Norfolk (Stroud, 1993)

-Stature:

-Trotter (1970).

-Cribra Orbitalia:

-Stuart-Macadam (1991).

-Other information on methods can be found in the microfiche.

Stratford Langthorne Abbey, Essex (White, 1999; Stuart-Macadam ,1985b, 1986)

-Age:

-Pubic symphysis (McKern and Stewart, 1957; Gilbert and Mckern, 1973; Brooks and Suchey, 1990).
-Suture closure (Meindl and Lovejoy, 1985).
-Dental attrition (Miles, 1963; Brothwell, 1981).
-Degeneration
-Epiphyseal union (Brothwell, 1981; Bass, 1995).
-Dental eruption (Brothwell, 1981).
-Diaphyseal length (Sundick, 1978; Hoffman, 1979; Ferembach *et al.,* 1980).

-Sex:

-Pelvis and skull morphology (Phenice, 1969; Ferembach *et al.*, 1980; Brothwell, 1981).
-Sacral, cranial and long bone.
-Tooth crown dimensions (Rosing, 1983).

-Stature:

-Trotter and Gleser (1952, 1958, 1970), lower limb bone used.

-Dental Pathology:

-Berry (1978).
-Hillson (1986).

-Tibial Periostitis:

-Rogers and Waldron (1989).