CHAPTER 7

THE RURAL POPULATION

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INTRODUCTION

The human skeleton offers a unique and multi-faceted resource that provides direct evidence for lived experiences in the past. Through use of the skeleton as physical evidence of morbidity (the disease rate within a population) and mortality (the frequency of death within a population) of the people who lived and died in Roman Britain, observations on social and biological relations can be made (see Larsen 1997; Gowland and Knüsel 2006; Gowland 2007). Palaeopathology, the study of trauma and disease in the past, allows us to explore a range of intrinsic and extrinsic factors that would have shaped life in the countryside of Roman Britain. Insights can be wide-ranging and include environmental factors, diet, migration and economy, climate, physical activity and access to medical treatment (Roberts and Manchester 2010).

Exposure to biocultural stress and infectious disease depends on the paucity of environmental factors, such as hygiene, sanitation or climate. The effects of both stress and disease further affect every individual differently depending on age, sex, genetic make-up, nutritional status and immune response. Risk of infection is greatly influenced by the synergistic relationship of poverty, poor diet and depressed immune function. In Roman Britain, exposure to new pathogens would have occurred through travel for migration and trade, or anthropogenic changes to the environment. Previous research on some of the urban settlements of Roman Britain has highlighted polluted, stressful and unsanitary living conditions. Osteologically, these can be observed via high levels of blood-borne diseases, enamel defects, respiratory and infectious diseases, and particularly the presence of tuberculosis in both adults and children (Roberts and Cox 2003, 118–19; Lewis 2011). We also see the first cases of leprosy reported in Britain at Roman Dorchester in Dorset, and Cirencester in Gloucestershire (Reader 1974; Manchester and Roberts 1986). The popular picture of Roman towns as centres of civilised public life, with running water, baths and toilets, has thus been challenged by the osteological data. Questions are being raised about our current perceptions of urban Romano-British life, but, as yet, we have little perspective on rural Roman Britons, and whether they experienced the same, or altogether different, stresses.

Rural life should in theory boast a number of health benefits, with access to a balanced diet, generous living space and clean air, all while offering respite from noise, pollution and overcrowding. If Roman Britain was indeed marked by social inequality, the beneficial aspects of country living would have been reserved for a privileged, high-status minority. Current theories paint a picture of demanding physical labour, and perhaps oppressive living and working conditions for the majority of rural Roman Britons (Pitts and Griffin 2012; Redfern *et al.* 2015; Rohnbogner and Lewis 2016a). Indeed, a range of contemporary issues would have exerted pressure on the rural population. The men, women and children of the countryside may have been forced to shoulder the heavy burden of taxation and supply in an aggressive market economy (Miles 1982; Whittaker and Garnsey 1997; Scheidel and von Reden 2002). Events such as the fourth-century A.D. famine in the Rhineland must have impacted on Romano-British producers and suppliers (Fulford 2004, 316; Allen and Lodwick 2017). Wellbeing in rural contexts would have been shaped by short-term weather fluctuations, regionally specific land use, prosperity of individual settlements, and the psychological aspects of being ruled, conquered or oppressed (McCarthy 2013). Additionally, the socially stratified nature of rural Romano-British society, particularly during the fourth and early fifth centuries A.D., will have shaped resource distribution and consequently wellbeing (Miles 1982; Whittaker and Garnsey 1997; McCarthy 2013; Redfern *et al.* 2015). We also have to question how much autonomy the rural population truly enjoyed and it has been suggested that people were living in 'enslaved' conditions as *coloni* or bonded tenants under the auspices of a landlord or villa owner (Jones 1982; Whittaker and Garnsey 1997; Esmonde Cleary 2004).

Children offer a unique window into past population health. Growing bodies are more sensitive to adverse environmental conditions and therefore provide a more accurate and precise form of evidence (Mensforth *et al.* 1978; Lewis 2007). It may be argued that the palaeopathological signatures of the children of Roman Britain are a very good example of Mattingly's (2006; 2010) arguments on unequal power relations governing life in the province. Non-adult palaeopathology has produced interesting new findings, including biased access to resources and inequality between urban and rural societies, evidence for internal rural–urban migration, and the impact of working lives on the young (Rohnbogner and Lewis 2016a).

THE BIOARCHAEOLOGICAL LITERATURE

The comprehensive discussion of health in Britain through the ages by Roberts and Cox (2003) marks one of the greatest efforts to gain insight into ill-health and everyday life of the Romano-British population of both town and country. The Roman-period sample used in their study comprised an impressive 5716 individuals from 52 urban and rural sites. It is worth pointing out that the palaeopathological data were mainly derived from reports dating from the 1970s to 1990s. This in turn carries with it certain limitations, as fewer osteological methods were available to researchers and there was generally less of a focus on the recovery and recording of all human remains during excavations. With palaeopathological analysis being a relatively new and emerging field, a lack of detail in older skeletal reports often becomes apparent and would have had an impact on the quality of data available to Roberts and Cox. Nevertheless, their tracing of patterns of disease in the British past is a significant contribution to the palaeopathological literature and provides us with a much-needed starting point for exploring health in the rural Romano-British population. Higher levels of ill-health were apparent in the urban sample from their study; however, rural sites were not devoid of pathology. Zoonotic diseases, respiratory ailments, congenital and neoplastic disease were observed in the rural cohort (Roberts and Cox 2003). In Dorset, shortcomings in wellbeing from the Iron Age through to the end of the Roman period were observed. The later period yielded shorter female stature, increased male mortality, dietary change and a rise in infectious and metabolic diseases (Redfern 2008; Redfern *et al.* 2010; 2012; Redfern and DeWitte 2011a; 2011b). A 2015 study by Redfern and colleagues on ill-health in the same region demonstrated that rural populations were less stressed than their urban peers, with better dental health and fewer incidences of metabolic disease. However, pressure on the rural population was apparent as higher mortality risk and lower survivorship. Pitts and Griffin (2012) provided a national overview of health and inequality in late Roman Britain. Their inter-cemetery approach examined palaeopathology and burial practices across Roman England by incorporating both published and unpublished data from major urban, nucleated and smaller rural settlements. The overall verdict was compromised health in the countryside, which correlated with greater inequality in grave furnishings. Ultimately, the study demonstrated that settlement type and connectivity to road systems conditioned health in late Roman rural sites.

Diet and access to resources are sensitive indicators of social stratification (Twiss 2012). It has been suggested that status differences between urban and rural communities resulted in greater dietary variability in the towns, as demonstrated by archaeobotany (Van der Veen *et al.* 2008), and isotope analysis (Richards *et al.* 1998; Redfern *et al.* 2010; Cheung *et al.* 2012; Müldner 2013), with more animal products and refined carbohydrates being consumed in higher status and urbanised settlements (King 1984; 1999a; 2001; Maltby 1989b; Van der Veen 2007a; 2008; Van der Veen *et al.* 2007; 2008; Cummings 2009; Nehlich *et al.* 2011; Müldner 2013). Apart from informing on dietary variation, isotopic studies on cemetery populations of York (Leach *et al.* 2009; Müldner *et al.* 2011), London (Montgomery *et al.* 2010), and Gloucester (Chenery *et al.* 2009), have provided insights on migration to major urban centres. In contrast, many authors have lamented that our current knowledge on migration to and from rural Romano-British settlements is limited (Redfern and Roberts 2005; Eckardt 2010a; Gowland and Redfern 2010; Eckardt *et al.* 2014; Redfern *et al.* 2015; Rohnbogner and Lewis 2016a).

The peoples inhabiting the countryside of Roman Britain would have found employment in a variety of occupations. Although it is fair to claim that the vast majority was involved in agricultural labour, a considerable number of individuals would also have worked in extraction and construction industries, manufacture and as craftsmen or traders (McCarthy 2013; Smith 2017). Roberts and Cox (2003) found that trauma, along with spinal and joint degeneration, were relatively high in Roman Britain. This would of course be a general observation for inhabitants of both town and country. However, compared to earlier periods, the data demonstrate that the bones and joints of Roman Britons were under increasing stress and exposed to wear and tear through physical activity.

There is some evidence for access to medical care on rural settlements. Embryotomy, intended to save the mother's life during complications at birth, was identified at Yewden villa in Hambleden, Buckinghamshire (Mays *et al.* 2014). In addition, a case of amputation at the humerus was reported from Alington Avenue in Dorchester, Dorset (Waldron 1989), although this may have been accidental. Although examples are few, these cases highlight that surgery was practised on rural sites, allowing us to hypothesise that other means and methods of medicinal aid were also available.

A BRIEF NOTE ON PALAEOPATHOLOGY AND BURIAL PRACTICE

Attitudes towards the dead may be a reflection of their status, perception and treatment in life. The osteological record can be a helpful window into exploring whether physiological characteristics of the deceased influenced motivations behind any unusual burial rites. Prone burials, decapitated burials and furnished graves often spark debate about the social processes, for example marginalisation or hierarchies, which may have prompted this type of 'othering' in death (Milella *et al*. 2015). The reader is directed to Chapter 6 for a discussion of burial archaeology in rural Roman Britain, and an appraisal of the phasing and distribution of grave goods, prone and decapitated burials.

Prone burials carry the notion of a 'deviant' or somewhat less respectful rite, often found in close association with unusual features within or outside the formal cemetery area (Philpott 1991, 72; Aspöck 2008; see Ch. 6, p. 229). The practice tends to occur in adults from rural contexts (Boylston *et al*. 2000; Roberts and Cox 2003, 153), but was also identified in children with a disability, sometimes buried in elaborate graves (Farwell and Molleson 1993, 265; Southwell-Wright 2014). Taylor (2008, 110) suggested that prone burial in Roman Britain ensured security of the body, perhaps enabling a safer resting place or transition to the afterlife. The decision-making behind prone burial may involve complex processes, reflecting the unique characteristics of the deceased or even the grieving (Philpott 1991, 74; Strück 2000; Parker Pearson 2003, 54; also see Crerar 2016). Decapitated burials present additional challenges and may have occurred more frequently than the burial data currently suggest. Preservation often prevents us from differentiating peri- from post-mortem decapitation, or intentional removal and displacement of the head altogether (Milella *et al*. 2015). It is not possible to distinguish between decapitations that occurred during life and subsequently caused death, or immediately after death, as bone will react to trauma in the same way (see Boylston *et al.* 2000 for an appraisal of decapitation burials at Kempston, Bedford, and Anderson 2001 for two decapitated adult males from Towcester, Northamptonshire). Apart from some notable exceptions (see Wells 1982 for a discussion of six decapitated individuals from Roman Cirencester), it is generally accepted that decapitation in Romano-British inhumation burials rarely resulted from execution or warfare and was undertaken post-mortem (Boylston *et al.* 2000; for a contrary view see Tucker 2015). Rather than reserving it for capital punishment, or branding it as a rite for individuals on the fringes of society, a ritualistic aspect is assigned to these burials (Philpott 1991). Great media attention has been devoted to the unusual assemblage of the 46 'headless Romans' at Driffield Terrace, York, most notably due to isotopic and genome analyses that have revealed both local and non-local origins of the skeletons (Müldner *et al.* 2011; Martiniano *et al.* 2016). Some of these young and middle adult men suffered peri-mortem decapitation, meaning their injuries were sustained at the time of death, which allows us to speculate whether they were executed. Owing to their palaeopathology including ante- and peri-mortem trauma, and lesions indicative of early childhood stress, the group has been interpreted as possible gladiators or soldiers (Martiniano *et al.* 2016). Although we do not expect to find such sensational correlations between burial practice and skeletal lesions, it is of interest to evaluate the palaeopathology of the men, women and children afforded the same rite across rural Roman Britain.

INTERPRETATIVE FRAMEWORKS IN BIOARCHAEOLOGY

The study of skeletal remains as a means of measuring population health and demographics in Roman Britain has received considerable criticism (see Parkin 1992), and as Scheidel (2012) has advised, no standard Roman demographic pattern exists. Naturally, as with any data in archaeology, there is bias in the study of human remains. How representative a sample may be is influenced by a range of factors, such as preservation, burial practices and excavation strategies, all of which have a profound effect on the skeletal data available to osteoarchaeologists (Gowland 2001; Pinhasi and Bourbou 2008). The buried population from rural Roman Britain is in itself a biased sample, as much of the rural population would not have received a formal burial in the first instance (see Ch. 6). Other factors include the fluctuating rates of infant burials in both urban and rural Romano-British cemeteries, migration influencing the demographic and palaeopathological make-up within a cemetery, and burial grounds that may have served a number of satellite settlements (see a number of studies concerned with the topic, i.e. Philpott 1991, 101; Scott 1991, 120; Pearce 1999; 2013; Esmonde Cleary 2000; Redfern and Roberts 2005; Wileman 2005; Moore 2009; Gowland and Redfern 2010; Gowland *et al.* 2014; Millett and Gowland 2015; Redfern *et al.* 2015). Lastly, an osteological sample is never a true reflection of the people that lived and worked within any given temporal or spatial locale. People move, and chronic diseases yield skeletal changes, whereas acute illnesses may not act on the body for long enough to prompt skeletal responses prior to death. Essentially, a population with plenty of pathology reflects a cohort that was strong enough to live through chronic and acute health insults. However, this very same cohort is susceptible to ill-health in the first instance (Wood *et al.* 1992; Goodman 1993).

MATERIALS AND METHODS

THE SAMPLE

Only inhumation burials were included in the analysis, with age, sex and pathological data extracted from reports post-dating 1995. A cut-off date of the mid-1990s was initially sought as older reports often fail to present the human skeletal remains in appropriate detail. Sites with fewer than ten reported inhumation burials were excluded to enable faster recording of a bigger sample. Without late Iron Age burials, the selection process initially yielded a total of 135 sites with 5043 inhumations. Three regional case studies were selected, based on the biggest samples, notably the Central Belt, South and East (TABLE 7.1; FIG. 7.1). Regions were kept deliberately broad to provide meaningful sample sizes for an overview of bioarchaeological data. Patchy skeletal recording, preservation, and, unfortunately in some cases missing or reburied skeletal remains, meant that a total of 322 individuals were recorded for the East, 741 for the South, and 1654 for the Central Belt (TABLE 7.2). A breakdown of individual sites for each region, including a site bibliography, is provided electronically in the online data archive (Allen *et al.* 2016).

Farmsteads are discussed as one settlement type. However, as outlined in Volume 1 by Allen and Smith (2016), we see differences in material culture and aspects of environmental data between complex, enclosed and unenclosed farmsteads. Combining all farmsteads into one settlement type enables analysis of more meaningful sample sizes. Otherwise as many as ten different settlement categories are introduced per region, with some types of farmstead represented by a single site and as few as ten inhumation burials only. The supplementary online tables provide a breakdown of sites, detailing the different types of farmsteads included in each region.

TABLE 7.1: POST-1995 SITES AND BURIALS BY REGION (EXCLUDING LATE IRON AGE SITES)

Region	*Sites n*	*Inhumations n*
Central Belt	67	2533
South	32	1420
East	15	687
North-East	14	333
Central West	2	29
North	1	20
South-West	1	21
Total	**132**	**5043**

AGE-AT-DEATH

Ages-at-death were summarised into age groups. Non-adults (0–17 years) were assigned to one of seven age groups, corresponding with developmental stages: perinate (<40 weeks gestation), 0.0–1.0 years, 1.1–2.5 years, 2.6–6.5 years, 6.6–10.5 years, 10.6–14.5 years and 14.6–17.0 years. For adults, the three broad age groups of 18–25 (young adult), 26–45 (middle adult) and >46 years (old adult) correspond with Pitts and Griffin's (2012) approach. Broad age groups were introduced to account for the difficulty associated with ageing fully developed skeletons. The age categories used are not an assumption of cultural ages or social transitions in the life course of Roman Britons, but reflect a biological construct that allows cross-comparison of the data and consolidates methodological discrepancies apparent in reports.

SEX

Sex was recorded in three categories, male (M) including probable and possible male, female (F) for probable and possible female, and unidentified/ambiguous (ua). Sex was not recorded in the children, as the accuracy of current sexing methods for immature skeletons remains debated (Sutter 2003; Lewis 2007).

THE PALAEOPATHOLOGY

Haematopoietic/blood-borne diseases

Pitting and porosity on the outer table of the skull (porotic hyperostosis, PH) and orbital roof (cribra orbitalia, CO), inform on blood-borne disorders. Non-adults display lesions more frequently due to a reduced capacity of sustaining higher red blood cell production. In adults, both CO and PH are therefore indicative of iron deficiency and megaloblastic anaemia in childhood. A largely plant-based diet, diarrhoeal disease and pathogen exposure, intestinal parasites and maladaptive breastfeeding and weaning practices may all contribute to blood-borne diseases, and in turn the formation of orbital and cranial lesions (Walker *et al.* 2009; Oxenham and Cavill 2010).

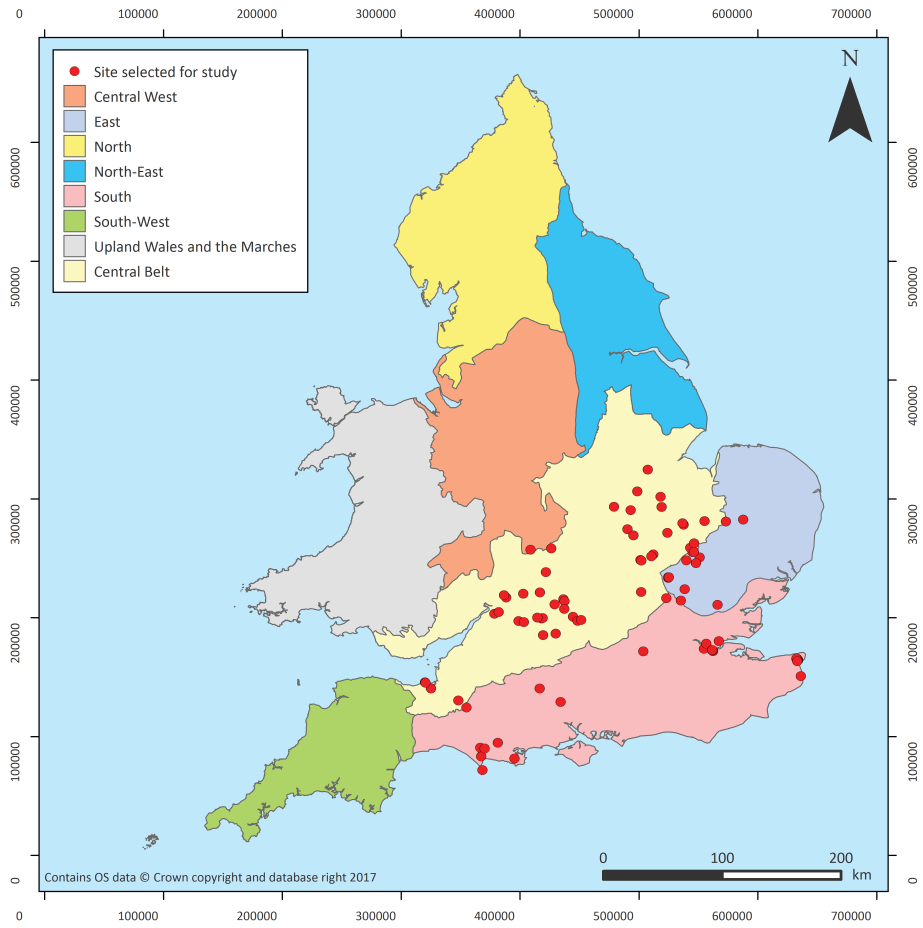

FIG. 7.1. Distribution of study sites across the regions

TABLE 7.2: SETTLEMENT TYPES AND PHASING OF THE REGIONAL CASE STUDIES

% of total inhumations within each region; *cemetery site without associated information on settlement type

	Central Belt		*South*		*East*		*Total*	
Site type	*Inh/sites n*	*%*	*Inh/sites n*	*%*	*Inh/sites n*	*%*	*Inh/sites n*	*%*
Defended small town	16/1	0.9					16/1	
Farmstead	425/21	25.7	156/8	21.1	142/5	44.1	723/34	26.6
Funerary*	761/9	46.0	256/8	34.5	37/1	11.5	1054/18	38.8
Industry	11/1	0.7					11/1	0.4
Port	25/1	1.5					25/1	0.9
Religious			58/1	7.8			58/1	2.1
Roadside	221/11	13.4	90/4	12.1	112/5	34.8	423/20	15.6
Villa	161/3	9.7	67/1	9.0	24/1	7.5	252/5	9.3
Village	34/1	2.1	114/4	15.4	7/1	2.2	155/6	5.7
Total	**1654/48**		**741/26**		**322/13**		**2717/87**	
Phase								
LIA/ER			131/5	17.7	52/2	16.1	183/8	6.7
ER	55/5	3.3	92/7	12.4	22/1	6.8	169/13	6.2
E–MR			53/3	7.2			53/3	2.0
MR	73/5	4.4	53/3	7.2	52/1	16.1	178/9	6.6
M–LR	163/5	9.9	104/4	14.0	11/1	3.4	278/10	10.2
LR	1312/34	79.3	308/12	41.6	106/6	32.9	1726/52	63.5
Roman	51/4	3.1			79/3	24.5	130/7	4.8
Total	**1654/53**		**741/34**		**322/14**		**2717/102**	

Enamel hypoplasia

Enamel hypoplasia (EH) is a defect resulting in linear bands or pits in tooth crown enamel. Defects occur most commonly on the crowns of permanent incisors or canines, formed up until the age of around four years old. As such, EH provide a permanent retrospective record of non-specific early childhood stress through fever and malnutrition (Goodman and Rose 1991; Reid and Dean 2000; King *et al.* 2005).

Infections of non-specific origin

Endocranial lesions (EL) on the inner table of the skull and sub-periosteal new bone formation (SPNBF) anywhere on the skeleton are indicative of inflammatory responses. Lesions may arise secondary to infection, trauma, circulatory disorders, joint disease, haematological disease, skeletal dysplasia, and metabolic or neoplastic disease. Infection can affect the cortex of the bone (osteitis) and medullary cavity (osteomyelitis). Responses may be prompted by fungal infections, parasites, viruses and the staphylococcus, streptococcus and pneumococcus bacilli (Nelson 1990; Goodman and Martin 2002; Roberts and Manchester 2010, 168).

Leprosy, tuberculosis and respiratory disease

Infection with the human strains of *Mycobacterium leprae* results in the chronic disease of leprosy. Together with a depressed immune status, the infection may lead to lepromatous leprosy, its most debilitating form, affecting nerve endings, the skin, nose and bones. The infection may take 5–20 years to fully develop, and although only mildly infectious, the disease is spread via infected droplets of the mouth or nose (Ortner 2003). Because of the stigma associated with the disease, sufferers are often ostracised by their community. Finding lepromatous leprosy therefore informs on frequent and close contact with other carriers of the disease (Roberts 2002; 2011). Tuberculosis (TB) is a chronic infectious disease of the lungs, skin, lymph nodes, intestines, and in rare cases bones and joints (Turgut 2001). There are several strains within the TB complex and *Mycobacterium tuberculosis*, the bacterial genus specific to humans, is spread via exhaled airborne droplets, sputum or human waste, or can be transmitted from an infected mother to the foetus. Ingesting infected animal product will spread the animal equivalent bacillus, *Mycobacterium bovis*, from bovines to humans (Stead 2000). TB affects bones and joints following a secondary infection or depressed immune status after an initial primary infection earlier in life. TB is therefore a valuable indicator for ongoing transmission and infection within a population (Santos and Roberts 2001; Roberts and Buikstra 2003).

Sinusitis of the maxillary sinuses, and new bone formation on the pleural surface of the ribs inform on respiratory ailments, such as bronchitis. Their presence informs on living environment and lifestyle, such as prolonged periods spent in low-quality air (Pfeiffer 1984; 1991; Boocock *et al.* 1995; Roberts *et al.* 1998a; 1998b).

Vitamin D deficiency (rickets and osteomalacia)

The prohormone vitamin D is vital to the formation and maintenance of healthy bone structure. It is absorbed via the intestine or formed by the skin's dermal cells in response to ultraviolet light (Brickley and Ives 2006). Rachitic children exhibit unmineralised bone that is porous in appearance and, when mechanical forces are applied, is prone to characteristic bending deformities (Thacher *et al.* 2006). Rickets can occur on a spectrum of vitamin D and calcium deficiency, therefore its presence not only points towards a lack of exposure to sunlight and associated cultural practices, but also calcium deficiency, maternal health, and child feeding practices (Kutluk *et al.* 2002; Pettifor 2004). Healed rickets can be observed in adults as the characteristic bowing of long bones; however, vitamin D deficiency at any age can be recognised as osteomalacia. Adult bone may soften as a result of calcium deficiency, either induced through dietary practices, malabsorption, loss from the body in kidney or intestinal disease, or indeed several pregnancies in close succession (Brickley and Ives 2008; Veselka *et al.* 2013).

Vitamin C deficiency (scurvy)

Vitamin C aids in the body's defence from infections, and is crucial for collagen formation and maintenance of body tissues. Collagen and osteoid synthesis is compromised in scorbutic individuals who also suffer from a reduced resistance to infections (Pimentel 2003). Skeletal growth is slowed down and sub-periosteal haematomas occur at weakened walls of small blood vessels, yielding characteristic porous patches of new bone, particularly in the skull (Brickley and Ives 2006). The skeletons of infants and young children are more likely to exhibit scorbutic lesions due to rapid growth (Brickley and Ives 2008; Stark 2014). Scurvy provides direct evidence for lack of fresh fruits and vegetables. In archaeological populations, widespread scurvy allows for exploration of dietary limitations shaped by resource stress, social hierarchies, ecology and behaviour (Crandall 2014; Halcrow *et al.* 2014).

Osteoporosis

Thinning of cortical bone and loss of trabecular structure is recognised as osteoporosis, resulting in lower bone density. Osteoporotic bone is more susceptible to fractures and characterised by a reduction of bone mass (Roberts and Manchester 2010). Osteoporosis is regarded as a chronic disease of advanced age, but the condition can also occur secondary to another underlying pathology, such as vitamin D deficiency in adults. The incidence of osteoporosis depends on age, lack of calcium in the diet, and various lifestyle factors, such as immobility, prolonged lactation and high number of pregnancies (Brickley 2002; Curate 2014).

Trauma

Dislocation, alteration to the shape of the bone, partial and complete breaks are distinct forms of skeletal injury observable in the osteological record (Ortner 2003). Most common are fractures in the upper limbs, hands and feet sustained by falls, rib fractures as a result of a direct blow to the thorax, and fractures of the lower limbs due to considerable force (Roberts and Manchester 2010). At times, the cause and severity of the injury can be discerned, allowing insight into activity patterns of past populations. For example, clay shovellers' fractures of the spinous process at the seventh cervical or first thoracic vertebra are caused by the repetitive strain of prolonged shovelling of heavy loads or similar motions that put a repeated strain on the back (Dellestable and Gaucher 1998; Jordana *et al.* 2006). Vertebrae may also separate into two parts at the lamina, the weakest point that connects the vertebral body and arch. The condition, termed spondylolysis, most commonly affects the fifth lumbar vertebra. Repetitive strain induced by lifting and bending at the site prompts stress fractures, which eventually lead to separation of the element (Waldron 1991a; Mays 2007). Osteochondritis dissecans (OCD), primarily a condition witnessed in young males, is a circular defect in the joint surface, commonly at the knee. Trauma causes disruption in the blood supply to the affected area, where affected bone tissue may die and separate from the joint area (Schenk and Goodnight 1996; Šlaus *et al.* 2010).

Joint degeneration

Degenerative joint disease is an expected occurrence of older age, where the strain of a physically active life will result in wear and tear or arthritic changes. However, if pronounced degeneration occurs in adolescents and young adults, it is an indicator of prolonged and demanding physical activity. Non-inflammatory joint disease can take on a variety of pathological processes owing to advancing age, strain or injury to a joint. Joint disease is primarily arthritic, occurring in the spine, upper or lower limbs, and extraspinal elements (Roberts and Manchester 2010). Osteoarthritis includes eburnation, osteophyte formation, pitting, deformation of the joint surface and new bone formation (Jurmain and Kilgore 1995; Weiss and Jurmain 2007). However, spinal joint disease does not always incur osteoarthritic changes but is also evident as degenerative disc disease (spondylosis), spinal osteophytosis and Schmorl's nodes among others (Burt *et al.* 2013, ch. 4). Degenerative disc disease is characterised by osteophytic lipping, and pitting and porosity of the vertebral body surface, sometimes accompanied by new bone formation (Rogers 2000). Osteophytosis at the margins of the vertebral bodies is a witness to the degeneration of the intervertebral joint capsule due to recurrent stress. Eventually, growth of bone is stimulated to compensate, and in extreme cases may lead to ankylosis of vertebral segments (Waldron 1991b). Schmorl's nodes indicate degeneration of the intervertebral discs. Disc herniation leads to the characteristic depressions on the superior or inferior aspect of vertebral bodies. Excessive loading of the spine in adolescence is thought to contribute to the formation of these lesions (Plomp *et al.* 2012).

Dental disease

Micro-organisms accumulate in the oral cavity. These may form plaque and mineralise on teeth as calculus (Hillson 1996). Diets high in protein and/or carbohydrates yield an alkaline environment that favours calculus deposition (Roberts and Manchester 2010, 71). Caries is an age-progressive infectious disease with localised demineralisation of dental hard tissues (Larsen 1997, 65). *Streptococcus mutans* and *sobrinus* in the oral cavity metabolise sugars and starches, creating an acidic environment leading to dental decay (Gussy *et al.* 2006). Ante-mortem tooth loss is caused by inflammation secondary to caries, periodontal disease, periapical lesions/abscesses and poor oral hygiene (Roberts and Manchester 2010, 74). Dental abscesses may form by bacterial infection of the pulp cavity secondary to caries. The inflammation produces pus and subsequent drainage, forming a cavity in the alveolar bone (Hillson 1996, 285–6). Abscesses are identified via radiographs or once they perforated the alveolar bone, meaning they may often go unnoticed in archaeological bone (Roberts and Manchester 2010, 70).

METHODS OF ANALYSIS

Morbidity and mortality were analysed as regional case studies. ArcGIS was used to visualise spatial distributions. Pathology was presented as crude prevalence rates by age and sex, as a percentage of the number of individuals affected in each region, site type and age category. The impact of periods of early childhood stress on survivorship was assessed by comparing non-adult and adult crude prevalence rates of enamel hypoplasia and cribra orbitalia.

The use of statistical testing will allow us to distinguish whether differences in lesion frequency between groups arose by chance, or, in the case of statistical significance, an underlying reason other than random chance. Differences between groups were tested using a non-parametric Chi-square test (X^2) at n-1 degrees of freedom (d.f.). The test was used sparingly, only when percentages suggested very different results. The number of degrees of freedom differs according to the number of independent values that are free to vary in a statistical calculation, such as, for example, the number of distinctive age groups or settlement classifications used. The confidence interval was set at 99.5 per cent ($p<0.005$) to avoid false positives. At 99.5 per cent confidence level, we only allow for a 0.05 per cent chance of uncertainty associated with the samples analysed.

RESULTS

General trends and statistical distributions in age-at-death, sex and palaeopathology are presented below, with brief descriptions of differences between groups. Crude prevalence rates are presented, as the nature of the skeletal data prevents more in-depth analysis. Some considerations on the biological data with respect to burial archaeology are described.

The East provided the smallest regional sample with 322 individuals and five different site types (TABLE 7.2). Funerary sites, villas and villages are represented by single examples, these being the village excavated at RAF Lakenheath, Caudle Head Mere, Suffolk, Chignal St James villa, Essex, and the cemetery site at Duxford, Cambridgeshire. The remaining sites comprise five farmsteads and five roadside settlements. A total of 741 individuals were reported for the South region. Only a single villa and religious site are represented, these comprising Bucknowle villa in Dorset, and Springhead Sanctuary complex in Kent. Since a large component of the infants and perinates from the Springhead Sanctuary complex were redeposited burials, their numbers were corrected for in the analysis and discussion. The Central Belt region provided the largest sample with 1654 individuals. The associated sites types include a single defended small town at Alcester, Warwickshire, a nucleated 'village' at Gill Mill, Ducklington, Oxfordshire, an industry/villa site at Priors Hall, Weldon, Northamptonshire, and an inland port at Camp Ground, Colne Fen, Earith in Cambridgeshire. For the Central Belt, no individual data for cribra orbitalia, porotic hyperostosis, enamel hypoplasia and dental disease were available for the large Cannington cemetery in Somerset. The 359 adults from this funerary site were therefore excluded from analysis for the respective lesions. Raw data for tables and graphs are available in supplementary tables on the online resource. In non-adults, infants were excluded from analysis for dental disease due to eruption timings of the deciduous dentition. Perinates were excluded from analysis for crude prevalence rates of enamel hypoplasia.

The total number of adults for the provincial rural sample is 1759. The results are presented for the adult population of the three regions pooled together, before presenting regional patterns. This will allow comparison of crude lesion frequencies with the contemporary fourth-century A.D. urban cemetery at Lankhills, Winchester, and preceding populations, dating from the early Iron Age to the early Roman period. The contemporary urban sample comprises 220 adults from Lankhills, Winchester (Clough and Boyle 2010). Roberts and Cox (2003) provide regional data for 398 sexed Iron Age adults from Britain. The comparative samples carry with them a number of limitations. The Iron Age sample is collated from skeletal reports dating as far back as the 1940s which, as discussed above, had an impact on the quality of data available. In contrast, the cemetery at Lankhills was excavated between 2000 and 2005 and all palaeopathological analysis was undertaken following the latest and most comprehensive methods, generating very accurate and precise data.

PALAEOPATHOLOGY OVERVIEW – THE ADULTS

The contemporary comparative sample comprises 220 adults from the urban cemetery at Lankhills, Winchester (Clough and Boyle 2010). Roberts and Cox (2003) provide regional data for 398 sexed Iron Age adults from Britain. The total number of adults for the provincial rural sample is 1759.

No cases of metabolic disease, porotic hyperostosis, osteomyelitis or sinusitis were reported in the Iron Age adults. For the remainder of lesions, we see a general increase in frequencies between the Iron Age and rural Romano-British populations. In the Iron Age, the crude prevalence rates for cribra orbitalia (4.8 per cent, n=19), endocranial lesions (0.5 per cent, n=2) and rib periostitis (0.3 per cent, n=1) are only marginally lower than in the rural population of Roman date. Osteitis occurred at a slightly elevated rate in the earlier period (0.5 per cent, n=2), compared to 0.3 per cent (n=5) in the Roman period. Enamel hypoplasia was reported at 10.9 per cent (n=153), compared to only 1.8 per cent (n=7) in the Iron Age, which is statistically significant (X^2=32.67, p<0.001, d.f.=1). New bone formation affected significantly fewer Iron Age adults (1.0 per cent, n=4) compared with rural Roman Britons (7.1 per cent, n=125; X^2=22.17, p<0.001, d.f.=1). To date, one case of tuberculosis from Iron Age Tarrant Hinton has been reported, and marks the oldest find of the disease in the British Isles (0.3 per cent, n=1). Trauma also affected significantly more adults in the Roman period at 12.1 per cent (n=212) compared to the Iron Age (6.5 per cent, n=26; X^2=10.36, p<0.001, d.f.=1) (TABLE 7.3; FIG. 7.2).

Over time, the crude prevalence of Schmorl's nodes statistically increased from 1.5 per cent in the Iron Age to 8.1 per cent in rural Romano-British populations (X^2=22.70, p<0.001, d.f.=1). Spondylolysis affected a similar proportion of adults in both periods (rural 1.5 per cent, n=27/ Iron Age 1.3 per cent, n=5). Overall, joint degeneration in the shoulder, hip and knee significantly increased from the Iron Age to affect 5.9 per cent (n=103), 7.0 per cent (n=124) and 4.9 per cent (n=87) of the rural adults respectively (shoulder: X^2=18.78, p<0.001, d.f.=1; hip: X^2=21.91, p<0.001, d.f.=1; knee: X^2=16.87, p<0.001, d.f.=1). The pattern was reversed for spinal joint disease, although at a less striking rate. Vertebral degeneration affected 32.7 per cent (n=130) of adults during the Iron Age, compared to 25.6 per cent (n=450) in the Romano-British countryside (TABLE 7.3).

A distinct difference was also found in the distribution of dental disease. Calculus affected 4.1 per cent (n=17) of adults in the Iron Age, compared to 25.4 per cent (n=356) of rural Roman Britons (X^2=121.27, p<0.001, d.f.=1). Significantly lower rates of caries (rural 26.9 per cent, n=377/Iron Age 4.8 per cent, n=16; X^2=95.95, p<0.001, d.f.=1) and ante-mortem tooth loss (rural 20.4 per cent, n=286/Iron Age 3.5 per cent, n=14; X^2=64.21, p<0.001, d.f.=1) were also found in the earlier period. Abscesses and/or periapical lesions were reported at similar frequencies of 6.8 per cent (n=27) in the Iron Age and 10.4 per cent (n=145) in the rural population of Roman Britain (TABLE 7.3).

No cases of porotic hyperostosis, endocranial lesions, osteitis, tuberculosis or vitamin C deficiency were reported in the adult population buried at Lankhills, Winchester. These lesions occurred in the countryside, albeit at low frequencies of 1.6 per cent (n=23) for porotic hyperostosis, 0.9 per cent (n=16) for endocranial lesions, 0.3 per cent (n=5) for osteitis, 1.0 per cent (n=18) for tuberculosis and 0.3 per cent for possible and probable vitamin C deficiency. Cribra orbitalia affected proportionately more adults at Lankhills (11.8 per cent, n=26/rural 6.6 per cent, n=92). Enamel hypoplasia was statistically more frequent among the urban adults at 22.7 per cent (n=50/rural 10.9 per cent, n=153; X^2=23.57,

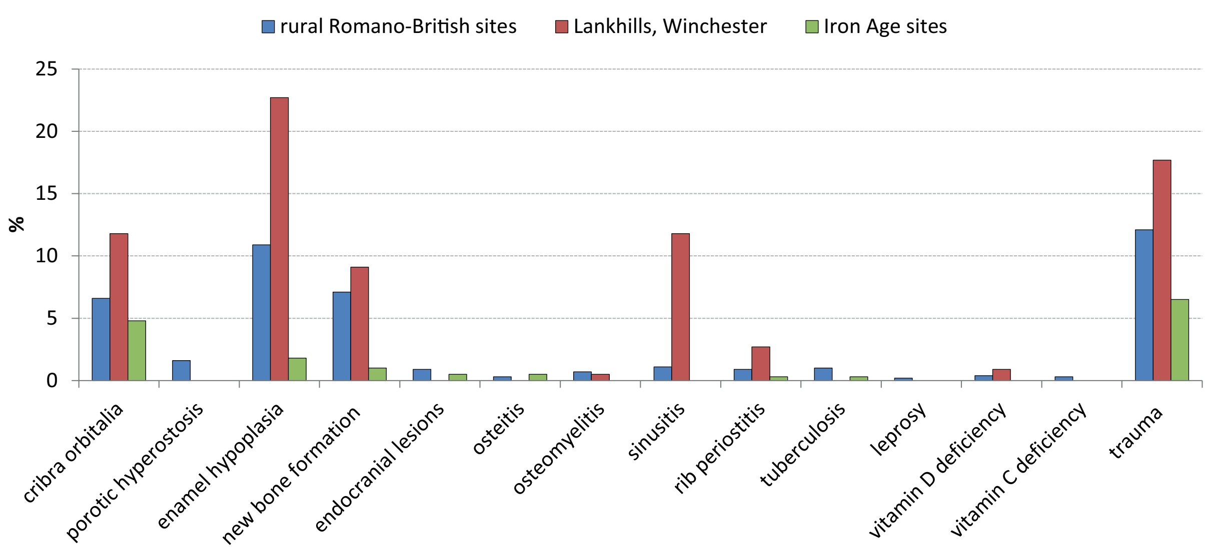

FIG. 7.2. Crude prevalence rates of pathology in the adult individuals from rural Roman Britain (all sites pooled), Lankhills, Winchester (Clough and Boyle 2010) and Iron Age Britain (Roberts and Cox 2003)

TABLE 7.3: THE ADULTS: POOLED PALAEOPATHOLOGY AND COMPARATIVE DATA
% of total number of adults observed; *n=6 secondary sinusitis due to dental abscess

	Rural Roman Britain			*Lankhills, Winchester*			*Iron Age (British data pooled)*		
	observed	*affected*	*%*	*observed*	*affected*	*%*	*observed*	*affected*	*%*
Cribra orbitalia	1400	92	6.6	220	26	11.8	398	19	4.8
Porotic hyperostosis	1400	23	1.6	220	0	0	398	0	0
Enamel hypoplasia	1400	153	10.9	220	50	22.7	398	7	1.8
Sub-periosteal new bone formation	1759	125	7.1	220	20	9.1	398	4	1.0
Endocranial lesions	1759	16	0.9	220	0	0	398	2	0.5
Osteitis	1759	5	0.3	220	0	0	398	2	0.5
Osteomyelitis	1759	13	0.7	220	1	0.5	398	0	0
Sinusitis	1759	19/25*	1.1	220	26	11.8	398	0	0
Rib periostitis	1759	16	0.9	220	6	2.7	398	1	0.3
Tuberculosis	1759	18	1.0	220	0	0	398	1	0.3
Vitamin D deficiency	1759	7	0.4	220	2	0.9	398	0	0
Vitamin C deficiency	1759	5	0.3	220	0	0	398	0	0
Trauma	1759	212	12.1	220	39	17.7	398	26	6.5
Joint stress									
Schmorl's nodes	1759	143	8.1	220	37	16.8	398	6	1.5
Spondylolysis	1759	27	1.5	220	5	2.3	398	5	1.3
Joint-specific rates of degeneration									
Shoulder	1759	103	5.9	220	8	3.6	398	2	0.5
Spine	1759	450	25.6	220	48	21.8	398	130	32.7
Hip	1759	124	7.0	220	3	1.4	398	4	1.0
Knee	1759	87	4.9	220	3	1.4	398	2	0.5
Dental disease									
Calculus	1400	356	25.4	220	63	28.6	398	17	4.1
Caries	1400	377	26.9	220	83	37.7	398	16	4.8
AMTL	1400	286	20.4	220	83	37.7	398	14	3.5
Abscess/PAL	1400	145	10.4	220	27	12.3	398	27	6.8

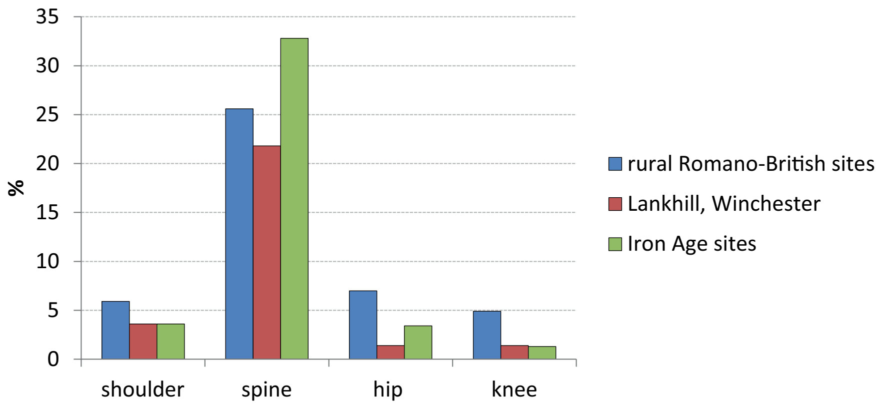

FIG. 7.3. Location-specific crude prevalence rates of joint degeneration in the adult individuals from rural Roman Britain (all sites pooled), Lankhills, Winchester (Clough and Boyle 2010) and Iron Age Britain (Roberts and Cox 2003)

$p<0.001$, d.f.=1). A marginally higher rate of sub-periosteal new bone formation was apparent at Winchester (9.1 per cent, n=20), although osteomyelitis was proportionately more frequent in the rural sample (0.7 per cent, n=13). Sinusitis was reported significantly less often in the countryside at 1.1 per cent (n=19), compared to Winchester with 11.8 per cent (n=26) of adults affected (X^2=97.94, $p<0.001$, d.f.=1). Rates of periosteal new bone on the pleural aspect of ribs were also higher in the town (2.7 per cent, n=6). Vitamin D deficiency was equally low in the countryside (0.4 per cent, n=7) and at Lankhills (0.9 per cent, n=2) (TABLE 7.3; FIG. 7.2).

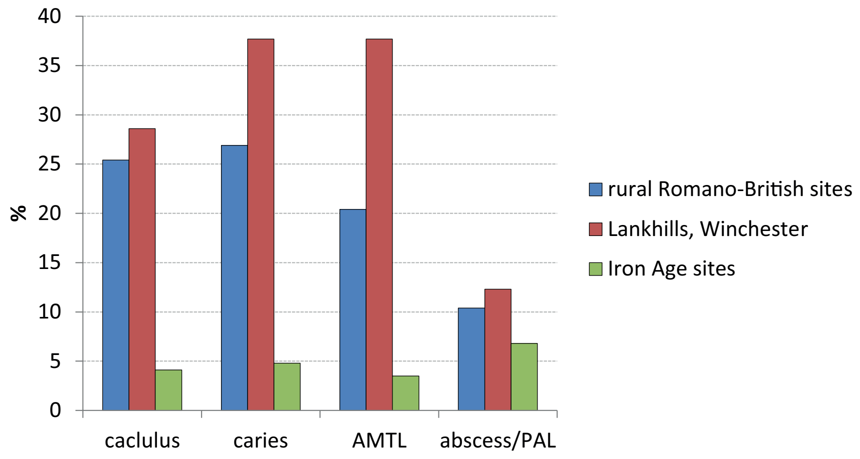

FIG. 7.4. Crude prevalence rates of dental disease in the adult individuals from rural Roman Britain (all sites pooled), Lankhills, Winchester (Clough and Boyle 2010) and Iron Age Britain (Roberts and Cox 2003)

Spondylolysis as a marker of joint stress affected the adults of the countryside and at Winchester at similar frequencies of 1.5 per cent (n=27) and 2.3 per cent (n=5) respectively. Although spinal joint stress apparent as Schmorl's nodes affected significantly more adults in the Lankhills cemetery (16.8 per cent, n=37/rural 8.1 per cent, n=143; X^2=17.20, p<0.001, d.f.=1), degeneration of the spine was reported in proportionately more adults from rural sites (25.6 per cent, n=450). Degeneration of the shoulder joint was less frequent at Roman Winchester 3.6 per cent, n=8) and statistically fewer adult individuals at the site were reported with degenerative joint disease at the hip and knee (1.4 per cent, n=3; hip: X^2=15.34, p<0.001, d.f.=1; knee: X^2=9.15, p<0.005, d.f.=1) (TABLE 7.3; FIG. 7.3).

Calculus and abscesses/periapical lesions were reported at similar frequencies between the urban and rural populations, at rates of 28.6 per cent (n=63)/25.4 per cent (n=356) and 12.3 per cent (n=27)/10.4 per cent (n=145) respectively. Caries and ante-mortem tooth loss were significantly more prevalent in the urban sample at 37.7 per cent (n=83), compared to 26.9 per cent (n=377) and 20.4 per cent (n=286) in the rural population (caries: X^2=10.74, p<0.005, d.f.=1; AMTL: X^2=31.96, p<0.001, d.f.=1) (TABLE 7.3; FIG. 7.4).

REGIONAL ANALYSIS

Age-at-death in the East

The East region includes 238 adults (73.9 per cent) and 70 non-adults (24.5 per cent). A total of 48.9 per cent (n=128) of adults died between 25 and 46 years old. Old adults were most frequently reported from complex and unclassified farmsteads (23.9 per cent, n=34), and the village at RAF Lakenheath, Caudle Head Mere, Suffolk (42.9 per cent, n=3), which is statistically significant (X^2=36.89, d.f.=4, p<0.001). Significantly more middle adults stem from the funerary site at Duxford, Cambridgeshire, and Chignal St James villa in Essex (X^2=34.11, d.f.=4, p<0.001). Old adults are significantly more prevalent in the early Roman phase (n=9, 40.9 per cent; X^2=36.50, d.f.=5, p<0.001) (FIGS 7.5–7.6).

Perinates account for 27.8 per cent (n=22) of non-adult burials, with a further 31.6 per cent infants (n=25). Significantly more perinates were reported from roadside settlements (21.4 per cent, n=24; X^2=47.62, d.f.=4, p<0.001) (FIG. 7.5). Phasing of the perinate and infant cohort did not produce any useful results as the majority of individuals (96.0 per cent, n=24) fell within the 'Roman' phase (FIG. 7.6). Overall, fewer individuals died after infancy; however, we see slight increases in mortality rates at 2.6–6.5 years old to 2.5 per cent (n=8) and at 14.6–17.0 years old to 2.2 per cent (n=7).

Age-at-death in the South

The South region includes 388 adults (52.4 per cent) and 351 non-adults (47.4 per cent). The majority of adults died between 26 and 45 years old (53.6 per cent, n=173). Only a single young adult (1.7 per cent) was reported from the religious site at Springhead, Kent. High numbers of middle adults are apparent from complex, enclosed, unenclosed and unclassified farmsteads (26.9 per cent, n=42) and funerary sites (36.7 per cent, 94), although differences are not statistically significant (FIG. 7.7). The early Roman phase is characterised by low numbers of 18–25 year olds (3.3 per cent, n=3), particularly in comparison to young adult burials from the late Iron Age/early Roman phase (12.2 per cent, n=16) (FIG 7.8).

High numbers of infant burials were reported from Springhead Sanctuary complex (74.1 per cent, n=43), but the site was excluded from statistical analysis due to redeposition of burials.

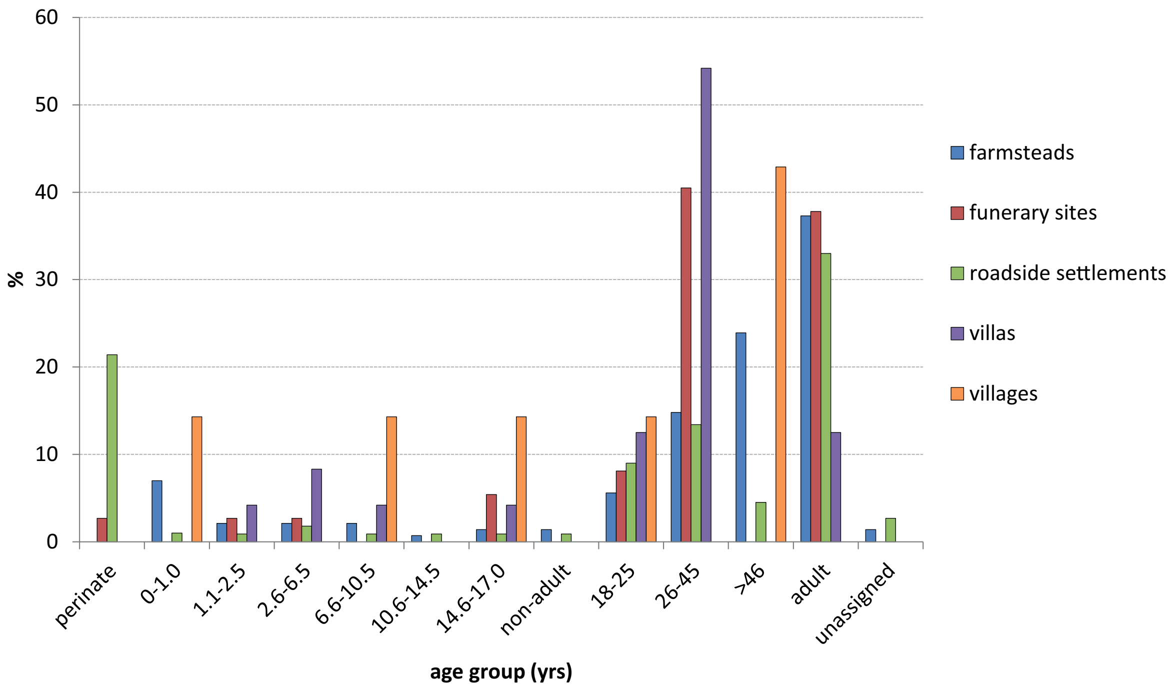

FIG. 7.5. East: distribution of ages-at-death by site type

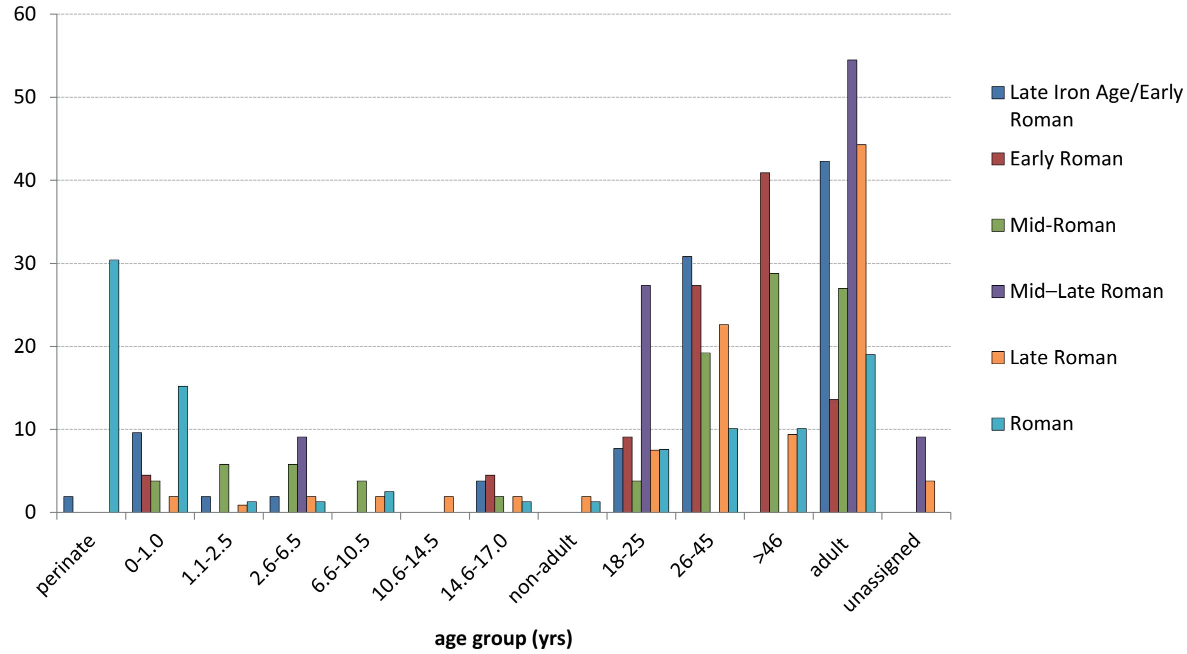

FIG. 7.6. East: distribution of ages-at-death by phase

Perinate burials are proportionately low (10.2 per cent, n=30), compared to 57.0 per cent (n=167) infant burials, which were particularly high at Bucknowle Roman villa, Dorset (88.1 per cent, n=59). Funerary sites were devoid of perinate burials and held significantly fewer infant burials (5.9 per cent, n=15; X^2=226.99, p<0.001, d.f.=4) (FIG. 7.7). There are few perinate (1.6 per cent, n=5) and infant burials (9.4 per cent, n=5) of late Roman date, with significantly more infants reported from early to mid-Roman (66.0 per cent, n=35) and mid- to late Roman contexts (58.7 per cent, n=61; X^2=161.48, p<0.001, d.f.=5) (FIG. 7.8). Mortality rates decline from infancy, with a slight increase in 2.6–6.5 years olds (3.6 per cent, n=27) and 10.6–14.5 year olds (3.0 per cent, n=22).

Age-at-death in the Central Belt

The Central Belt region includes 1133 adults (68.5 per cent) and 509 non-adults (30.8 per cent). The majority of adults died between 26 and 45 years

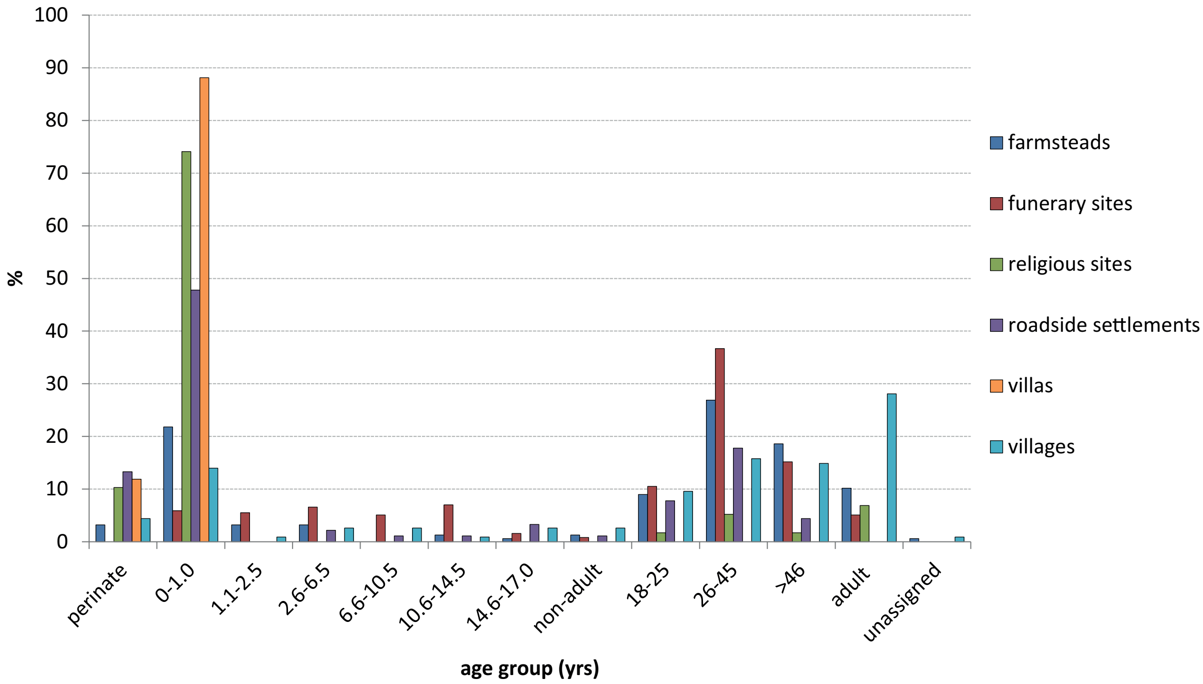

FIG. 7.7. South: distribution of ages-at-death by site type

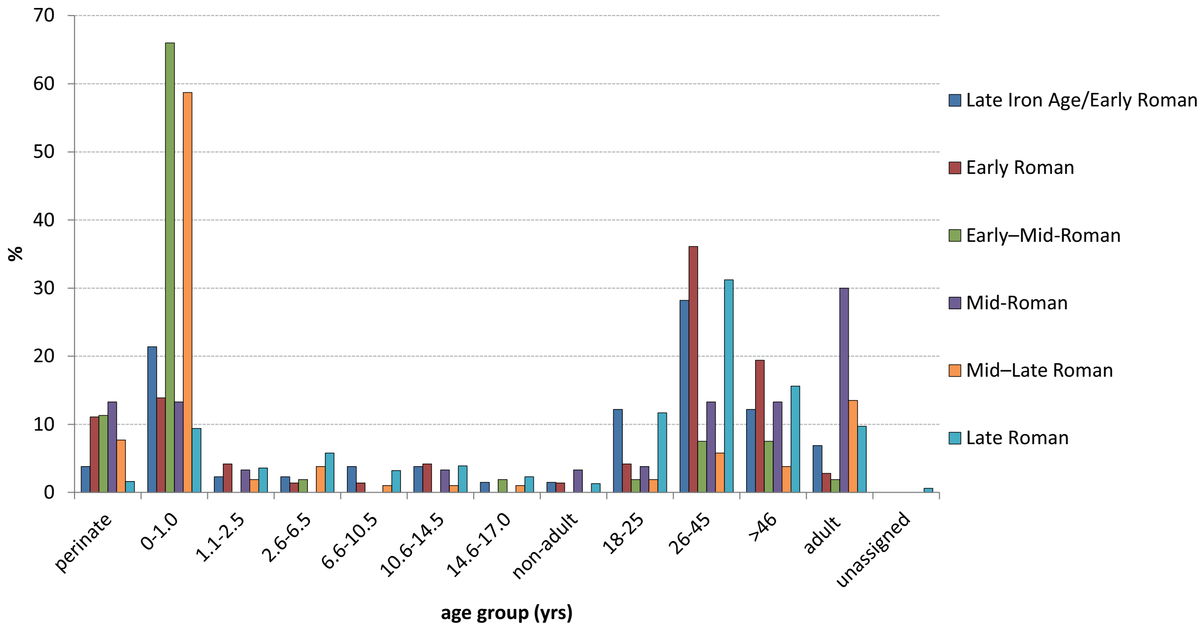

FIG. 7.8. South: distribution of ages-at-death by phase (corrected for redeposited burials from religious site)

old (23.8 per cent, n=394). A significantly lower number of middle adults was reported from villas (10.6 per cent, n=17; X^2=28.44, p<0.001, d.f.=6) (FIG. 7.9). The highest proportion of old adults stems from the industry/villa site at Priors Hall, Weldon, Northamptonshire (27.3 per cent, n=3). At the nucleated village at Gill Mill, Ducklington, Oxfordshire, young adult mortality was highest at 14.7 per cent (n=5). Since both these settlement types are represented by a single site each, we have to bear in mind small sample sizes.

Perinates (21.8 per cent, n=111) and infants (32.8 per cent, n=167) account for the majority of non-adult burials reported. Significantly lower rates of perinates were reported from complex and unclassified farmsteads (4.0 per cent, n=17), and funerary sites (2.9 per cent, n=22; X^2=120.15, p<0.001, d.f.=7). No perinates were reported at the industry/villa site at Priors Hall, whereas 40.0 per cent (n=10) of the individuals reported from the inland port at Camp Ground, Colne Fen in Cambridgeshire, were perinates. Statistically fewer

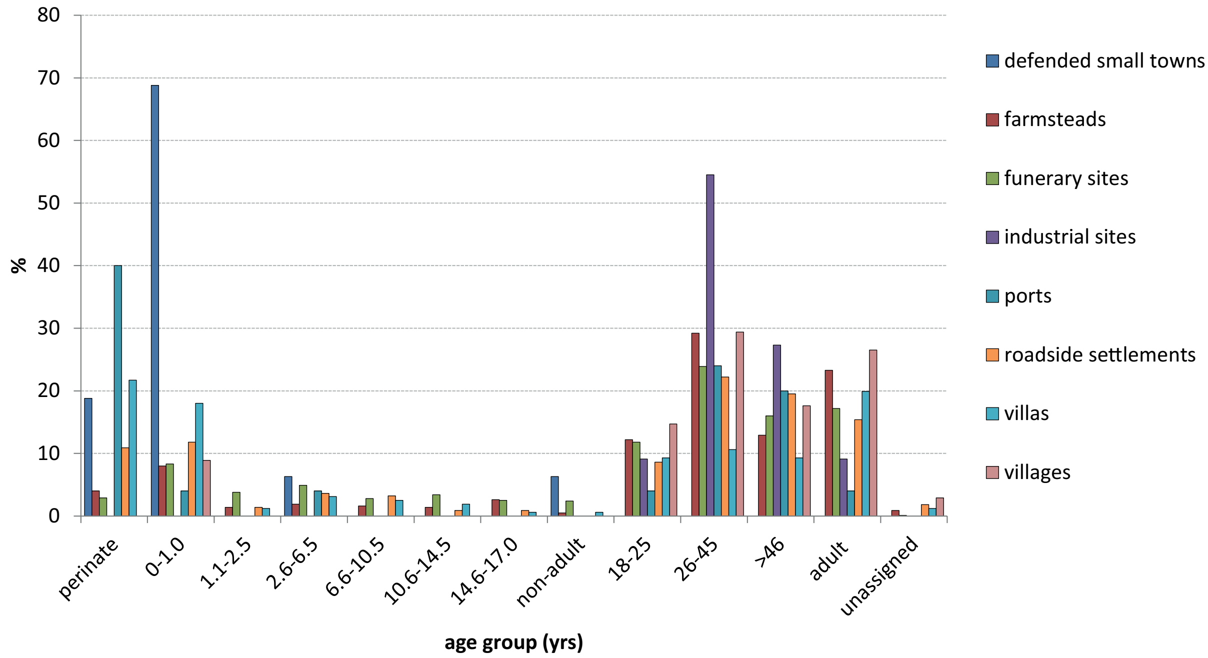

FIG. 7.9. Central Belt: distribution of ages-at-death by site type

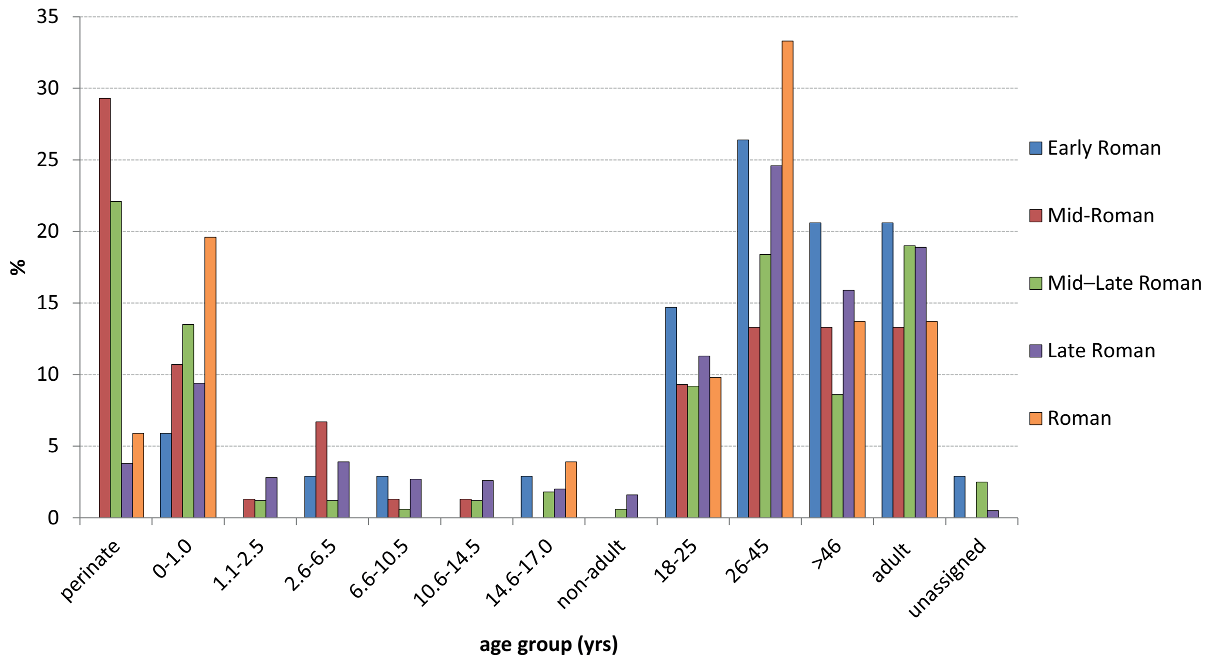

FIG. 7.10. Central Belt: distribution of ages-at-death by phase

perinate burials were of early (n=0) and late Roman date (3.8 per cent, n=50; X^2=139.64, p<0.001, d.f.=3). A significant proportion of burials at the only defended small town (Alcester) are infants (68.8 per cent, n=11; X^2=76.60, p<0.001, d.f.=7). Phasing of infant burials is uninformative owing to a large component in the dated 'Roman' group (19.6 per cent, n=10) (FIGS 7.9 and 7.10). In the non-adults, mortality rates decline after infancy, although there is a slight increase at 2.6–6.5 years old (3.6 per cent, n=60).

Sex distribution in the East

A total of 151 (63.4 per cent) of the 238 adults were sexed, with a slightly higher proportion of males (34.9 per cent, n=83) than females (28.6 per cent, n=68). Similar distributions are apparent at complex and unclassified farmsteads (male 32.7 per cent, n=38/female 30.2 per cent, n=35) and roadside settlements (male 25.4 per cent, n=17/female: 23.9 per cent, n=16) (FIG. 7.11). Twice as many males (50.0 per cent, n=16) were reported from the Duxford funerary

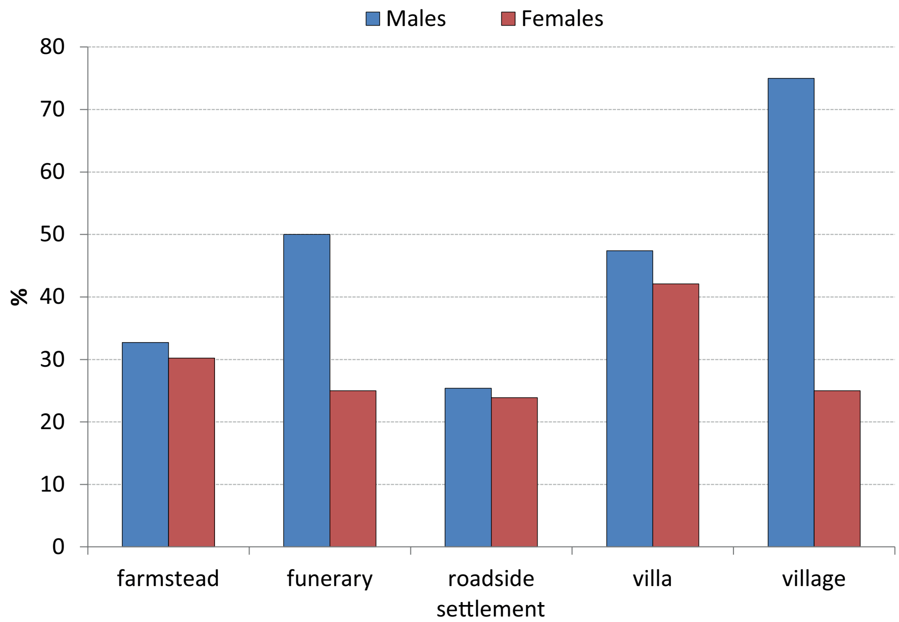

FIG. 7.11. East: adult sex distribution by site type

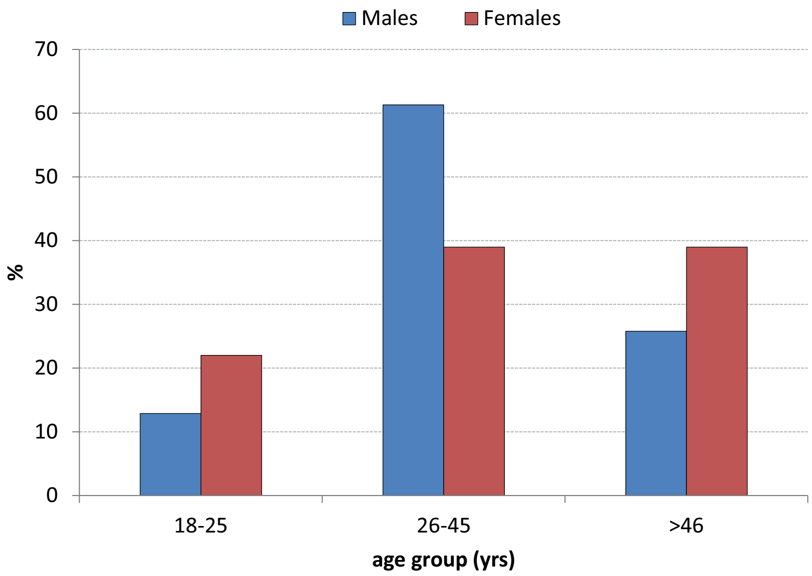

FIG. 7.12. East: sex distribution in the adults

site than females (25.0 per cent, n=8), which is a result of small sample sizes. The same issue applied to the only village site of the region, at RAF Lakenheath, Caudle Head Mere, in Suffolk, where 75.0 per cent (n=3) of the sample were reported as male, compared to only one female (FIG 7.11). More females were reported aged 18–25 years old (22.0 per cent, n=13) and over 46 years old (39.0 per cent, n=23) than males (FIG. 7.12). The majority of males died at 26–45 years old (61.3 per cent, n=38), whereas 39.0 per cent (n=23) of females fall into the 26–45 and >46 year age groups.

Sex distribution in the South

A total of 79.1 per cent (n=307) of adults were sexed, and more males (42.3 per cent, n=164) reported than females (36.9 per cent, n=143). This is also reflected by settlement type, although males (45.1 per cent, n=78) and females (43.9 per cent, n=76) were reported at similar frequencies at funerary sites (FIG. 7.13). Almost twice as many males (33.3 per cent, n=9) were from roadside settlements than females (18.5 per cent, n=5) but sample sizes are small. The same issue applies to the high rate of males (55.6 per cent, n=5) compared to females (11.1 per cent, n=1) at the

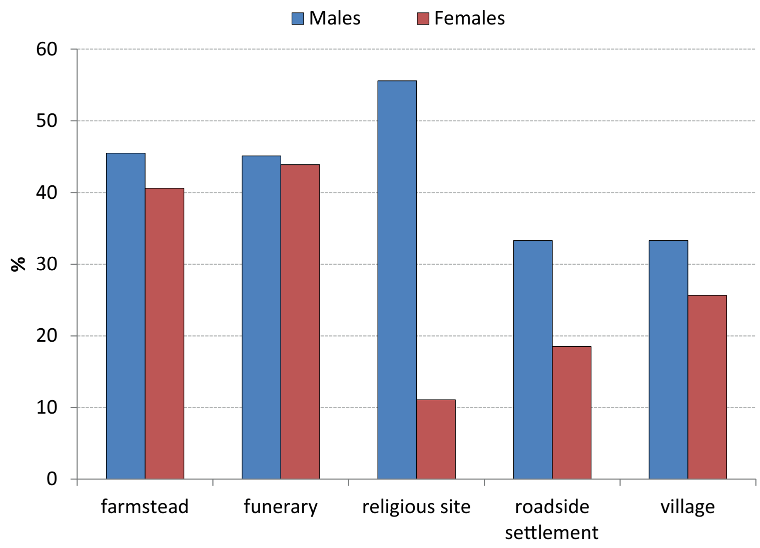

FIG. 7.13. South: adult sex distribution by site type

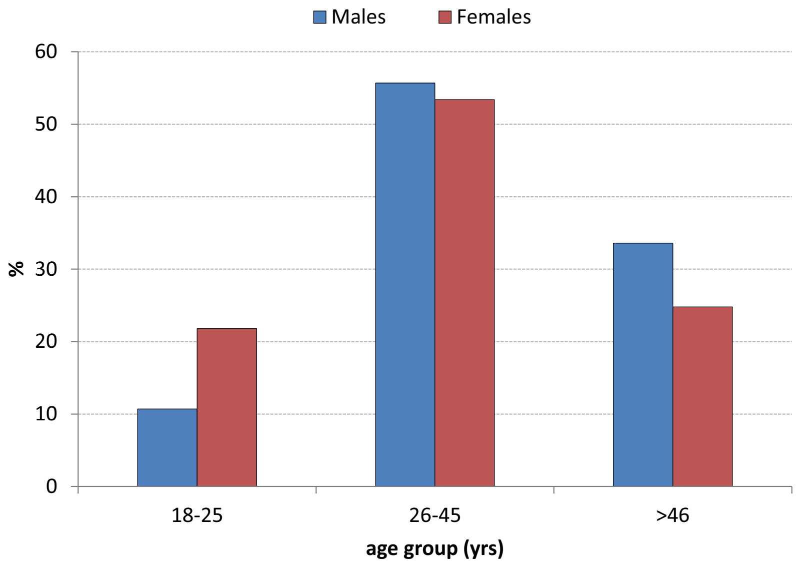

FIG. 7.14. South: sex distribution in the adults

only religious site at Springhead Sanctuary complex in Kent. Proportionately more young adult females were present (21.8 per cent, n=29/young adult males: 10.7 per cent, n=16), and males were more frequently reported in the old adult age group (33.6 per cent, n=50/old adult females: 24.8 per cent, n=33) (FIG. 7.14).

Sex distribution in the Central Belt

A total of 886 (78.2 per cent) of the 1133 reported adults were sexed. Males and females were reported at similar frequencies (male: 39.3 per cent, n=445/female: 38.9 per cent, n=441). More young adult females were reported (25.5 per cent, n=92), compared to 17.2 per cent of young adult males (n=67). Proportionately more males were reported for the middle (55.7 per cent, n=83/female: 53.4 per cent, n=71) and old adult age groups (33.6 per cent, n=50/female: 24.8 per cent, n=33) (FIG. 7.15). No adults were reported at the only defended small town of the region, Alcester, Warwickshire. Females outnumbered males in funerary sites (female: 45.3 per cent, n=238/male: 41.0 per cent, n=215), and villas (female: 39.2 per cent, n=31/male: 25.3 per cent, n=20). Twice as many males were reported from the industry/villa site at Priors Hall, Weldon, Northamptonshire; however, sample sizes are small (male: 60.0 per cent, n=6/female: 30.0 per cent n=3) (FIG. 7.16).

Non-adult palaeopathology in the East

Only a few non-adults were reported for the region, with low rates of palaeopathology. Cribra orbitalia was reported in a 1.1–2.5 year old from Chignal St James villa, Essex. Enamel hypoplasia was reported in three individuals, two aged 6.6–10.5 years old,

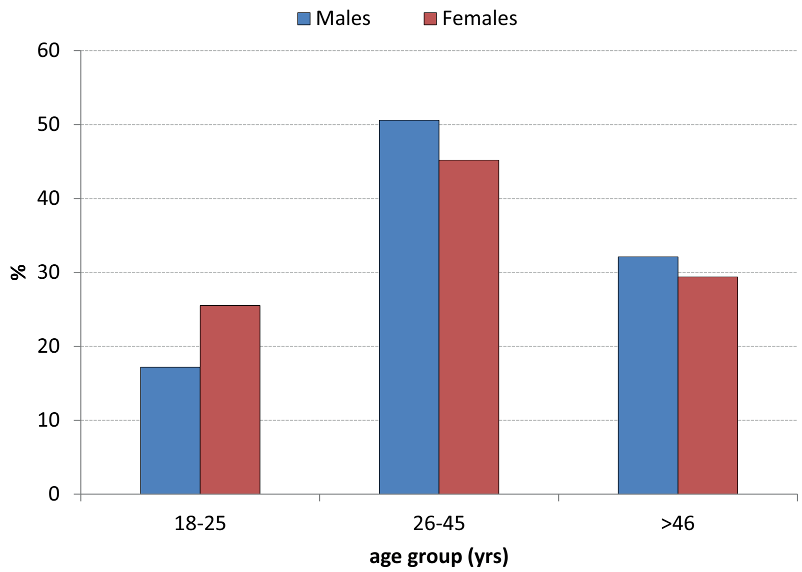

FIG. 7.15. Central Belt: sex distribution in the adults

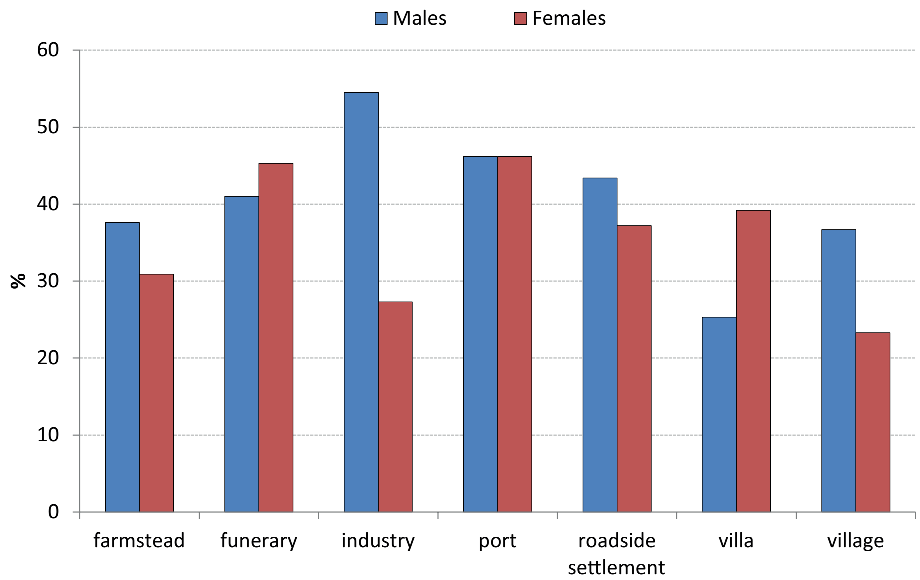

FIG. 7.16. Central Belt: adult sex distribution by site type

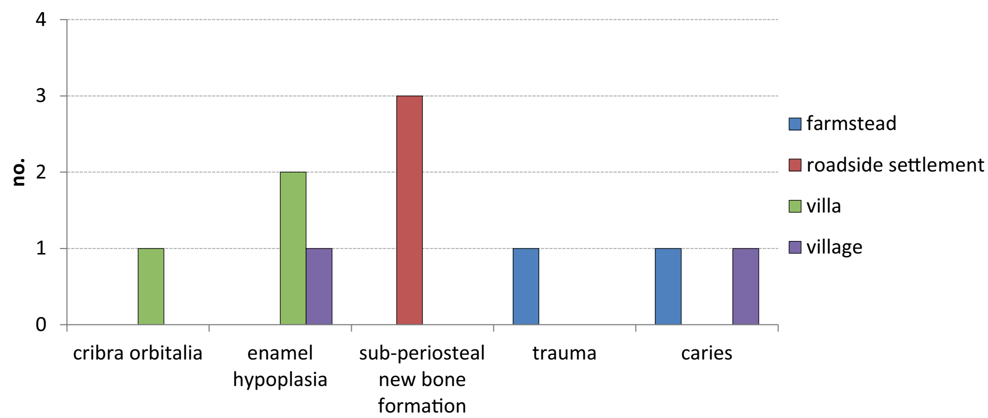

FIG. 7.17. East: numbers of non-adults with pathology

and one 14.6–17.0 year old adolescent from Chignal St James (40.0 per cent) and the village site at RAF Lakenheath (33.3 per cent), with an overall rate of 5.6 per cent for the region. Sub-periosteal new bone formation exclusively affected three non-adults from roadside settlements (7.1 per cent), including an infant, a 10.6–14.5 and a 14.6–17.0 year old. An infant from the complex farmstead at Clay Farm, Trumpington in Cambridgeshire, was reported with abnormal bone turnover, possibly indicative of an unknown metabolic disorder. A healed but poorly aligned fracture to the left tibial mid-shaft was reported in an adolescent from the unclassified farmstead at Babraham, Cambridgeshire (4.2 per cent). This individual was decapitated and buried in a grave furnished with pottery (Timberlake *et al.* 2007). Dental disease was infrequent, with one adolescent from the same site reported with calculus. Caries was reported in two individuals, a 2.6–6.5 years old from the unclassified farmstead at Babraham (7.1 per cent), and a 14.6–17.0 year old from the village site at RAF Lakenheath (50.0 per cent), with an overall rate of 6.3 per cent for the region (FIG. 7.17).

Non-adult palaeopathology in the South

Similar to the East, non-adult pathology was low in the South region. Cribra orbitalia was reported in children from funerary, roadside and village sites at CPRs of 4.8 per cent (n=4), 1.6 per cent (n=1) and 8.6 per cent (n=3). The youngest individuals with cribrotic lesions were two 2.6–6.5 year olds from the funerary site at Zone 19, East Kent Access, and the village at Amesbury, Boscombe Down, Wiltshire. The highest rate of CO was found in 14.6–17.0 year olds. Enamel hypoplasia was reported for all age groups, most frequent in 2.6–6.5 year olds (18.5 per cent, n=5) and villages (10.0 per cent, n=3). Small sample sizes yielded high lesion frequencies by age groups (FIG 7.18).

Osteomyelitis was reported at 0.6 per cent (n=3), in infants and a perinate, which is questionable given the quality of infant bone (Wenaden *et al.* 2005). The highest frequency of endocranial lesions was reported for villages (5.7 per cent, n=2), and in 2.6–6.5 year olds (7.5 per cent, n=2). Sub-periosteal new bone formation was highest in 14.6–17.0 year olds (18.2 per cent, n=2) and reported in a range of settlement types. Infants and older children exhibited new bone formation and metabolic disease was reported in a scorbutic 2.6–6.5 year old from the funerary site at Zone 19, East Kent Access, and a rachitic infant from a village site at Zones 6 and 7 of the East Kent Access. Skeletal trauma was not reported.

Calculus affected those aged 6.6–10.5 years and older (11.8 per cent, n=2), peaking in 14.6–17.0 year olds (45.5 per cent, n=5). Calcified plaque was most prevalent in roadside settlements (37.5 per cent, n=3). Overall, caries prevalence was highest in the village sites (21.4 per cent, n=3) and mainly affected 14.6–17.0 year olds (27.3 per cent, n=3).

Non-adult palaeopathology in the Central Belt

A total of 39 (7.7 per cent) non-adults were reported with cribra orbitalia. Prevalence was highest in funerary sites (11.5 per cent, n=27) and 1.1–2.5 year olds (25.0 per cent, n=10), although we see a variation of rates across the ages and settlement types (FIG 7.19). Porotic hyperostosis affected 2.4 per cent (n=12) overall. Lesions were most frequent in 1.1–2.5 year olds (10.0 per cent, n=4), and at roadside settlements (4.2 per cent, n=3). Enamel hypoplasia was reported in 7.5 per cent (n=30) of non-adults, with the highest frequency in 6.6–10.5 year olds (23.1 per cent, n=9) and in funerary sites (9.5 per cent, n=19).

Osteomyelitis was reported in a perinate from the roadside settlement at Wanborough, Wiltshire

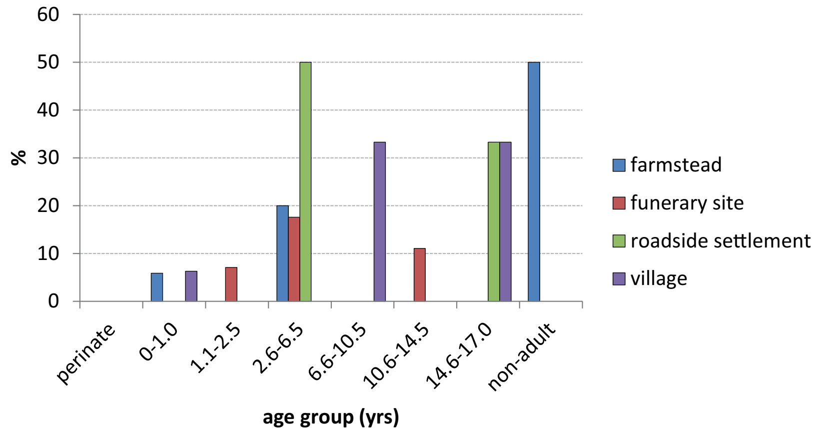

FIG. 7.18. South: crude prevalence rates of enamel hypoplasia in non-adults

(1.4 per cent), and osteitis in a 10.6–14.5 year old from the unclassified farmstead at Bradley Hill, Somerset (1.1 per cent). Endocranial lesions were reported across a range of settlement types. Lesion frequency was highest in 10.6–14.5 year olds (8.1 per cent, n=3), all from funerary sites. Subperiosteal new bone formation was reported in 3.9 per cent (n=20) of non-adults, most prevalent at roadside settlements (5.6 per cent, n=4) and in 14.6–17.0 year olds (21.2 per cent, n=7). In total, four individuals (0.8 per cent) from funerary sites and an unclassified farmstead (Foxes Field, Stonehouse, Gloucestershire) were reported with visceral new bone formation on the ribs, including an infant, two adolescents and a 6.6–10.5 year old.

Vitamin D and vitamin C deficiencies were reported at 1.6 per cent (n=8) and 4.1 per cent (n=21). Rickets was present in infants and 1.1–2.5 year olds from the roadside settlement at Bourton-on-the-Water, Gloucestershire (3.8 per cent, n=1) and the funerary sites at Cannington, Somerset, and Radley Barrow Hills, Oxfordshire (6.3 per cent, n=4/10.3 per cent, n=3). Scurvy was most prevalent in 1.1–2.5 year olds (17.5 per cent, n=7), and the roadside settlement at Bourton-on-the-Water, Gloucestershire (6.9 per cent, n=5), and the funerary site at Cannington, Somerset (6.0 per cent, n=14). Infantile scurvy was present at the unclassified farmstead at Bradley Hill, Somerset (5.9 per cent, n=2), whereas Bourton-on-the-Water and Cannington had a greater dispersal of vitamin C deficiency across the age groups (FIG. 7.20).

Trauma was reported in five non-adults (1.0 per cent) from the funerary site at Cannington, Somerset (n=2), the villa at Watersmeet, Cambridgeshire (n=1), the roadside settlement at Kempston, Box End, Bedford (n=1) and the unclassified farmstead at Bradley Hill, Somerset (n=1). Fractures were most prevalent in 2.6–6.5 year olds (3.3 per cent, n=2). Infants presented with a dislocated femur and fractured clavicle. A clavicle fracture was also present in the 2.6–6.5 year olds, alongside a green-stick fracture to the

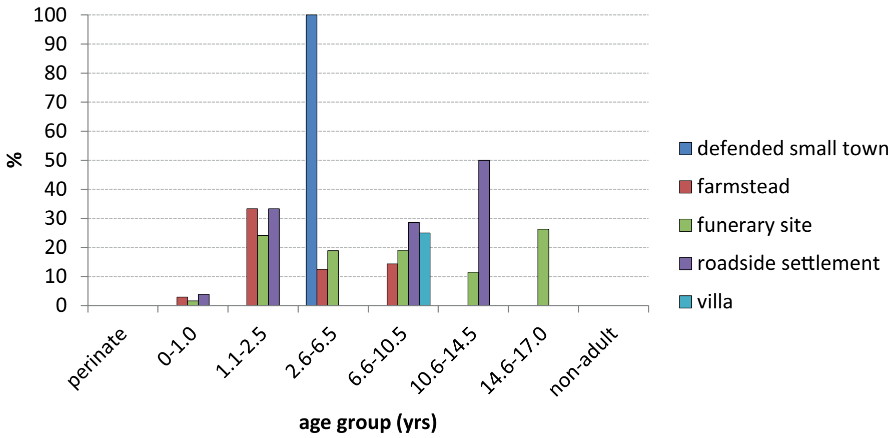

FIG. 7.19. Central Belt: crude prevalence rates of cribra orbitalia in non-adults

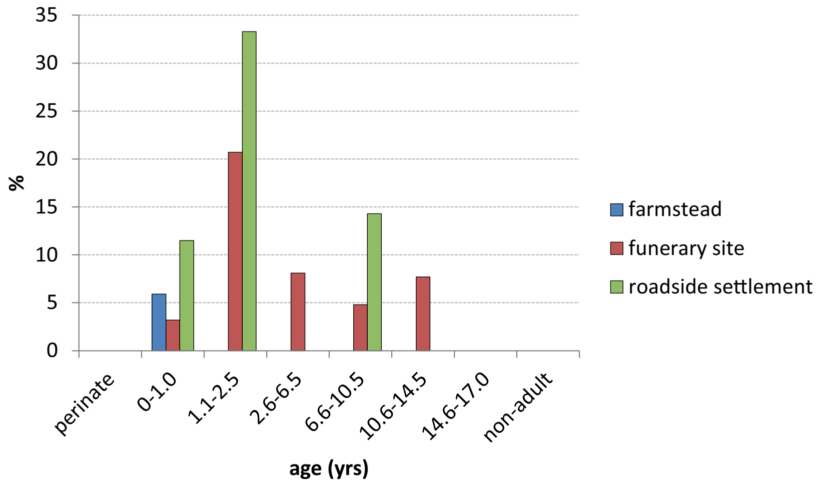

FIG. 7.20. Central Belt: crude prevalence rates of vitamin C deficiency in non-adults

fibula. The oldest individual is a 10.6–14.5 year old with a Monteggia injury affecting the left ulna and radius.

Calculus (7.5 per cent, n=15), caries (6.0 per cent, n=12) and AMTL (1.0 per cent, n=2) were reported, with increasing frequencies in older children. Caries was highest at villa sites (12.5 per cent, n=2), and farmsteads yielded a significantly higher rate of calculus (17.5 per cent, n=7; X^2=19.35, p<0.005, d.f.=5) than elsewhere in the region. Nine of the 14 farmsteads with non-adults with calculus were complex farmsteads, and the remaining four unclassified.

Adult palaeopathology in the East

A total of 13 adults were reported with haematopoietic lesions, with similar frequencies in males (7.2 per cent, n=6) and females (7.4 per cent, n=5). Significantly more individuals from Chignal St James villa were reported with porotic hyperostosis (21.2 per cent, n=4; X^2=15.32, p<0.005, d.f.=4) and enamel hypoplasia (47.4 per cent, n=9; X^2=68.22, p<0.001, d.f.=4). Overall, enamel hypoplasia was reported in 13 individuals (5.5 per cent). The crude prevalence of enamel lesions was similar among the adults and non-adults (non-adult CPR 5.6 per cent/adult CPR5.5 per cent), and cribra orbitalia occurred at low frequencies in both groups (non-adult CPR 1.3 per cent/adult CPR 2.9 per cent). New bone formation was reported in 12 individuals (5.0 per cent) and affected 2.9 per cent (n=2) of females and 9.6 per cent (n=8) of males (TABLES 7.4 and 7.5). Periostitis was significantly more frequent at the village at RAF Lakenheath, Suffolk (50.0 per cent, n=2; X^2=15.11, p<0.005, d.f.=4) than elsewhere across the region. Both osteitis (n=2) and endocranial lesions (n=2) were reported at the complex farmstead at Clay Farm, Trumpington, Cambridgeshire (1.7 per cent) (TABLE 7.6). Tuberculosis was equally rare and identified in two young females (0.8 per cent) from the complex farmstead at Hutchison Site, Addenbrooke's in Cambridgeshire (n=1) and the funerary site at Duxford (n=1) (FIG. 7.21). Sinusitis and visceral new bone formation on the ribs affected one individual each (0.4 per cent) (TABLE 7.7). A middle adult female from The Tene, Baldock roadside settlement in Hertfordshire (1.5 per cent) was reported with vitamin C deficiency.

Trauma was most prevalent at Chignal St James villa (26.3 per cent, n=5), and more commonly

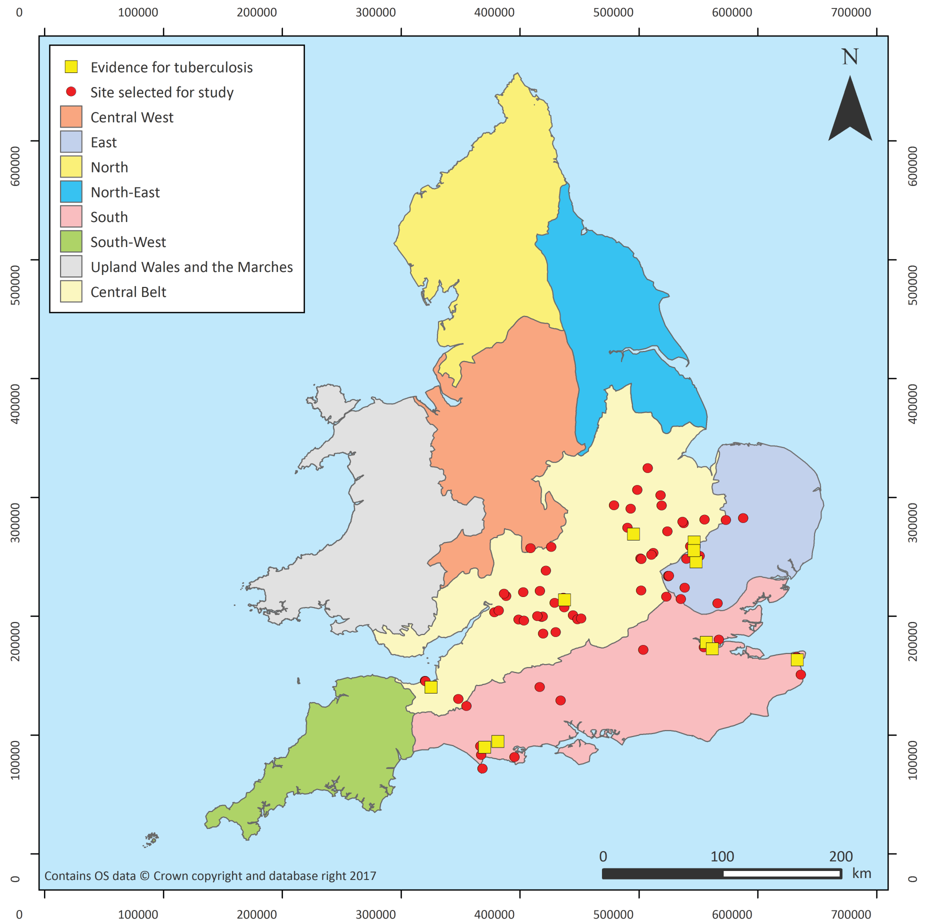

FIG.7.21. Distribution of sites with reported cases of tuberculosis

TABLE 7.4: ADULT CRUDE PREVALENCE RATES OF CRIBRA ORBITALIA AND POROTIC HYPEROSTOSIS
% of settlement type total

EAST	*Observed n*	*Affected n*	*CPR %*	*M*	*F*
Cribra orbitalia					
Farmstead	116	2	1.7	2	
Funerary	32	0	0		
Roadside	67	2	3.0		2
Villa	19	3	15.8	2	1
Village	4	0	0		
Total	**238**	**7**	**2.9**	**4**	**3**
Porotic hyperostosis					
Farmstead	116	1	0.9		
Funerary	32	0	0		
Roadside	67	0	0		
Villa	19	4	21.2	2	2
Village	4	0	0		
Total	**238**	**5**	**2.1**	**2**	**2**
SOUTH	*Observed N*	*Affected n*	*CPR %*	*M*	*F*
Cribra orbitalia					
Farmstead	101	8	7.9	5	3
Funerary	173	20	11.6	8	10
Religious	9	0	0		
Roadside	27	1	3.7	1	
Village	78	7	9.0	1	6
Total	**388**	**36**	**9.3**	**15**	**19**
Porotic hyperostosis					
Farmstead	101	0	0		
Funerary	173	2	1.2	1	1
Religious	9	0	0		
Roadside	27	0	0		
Village	78	2	2.6	2	
Total	**388**	**4**	**1.0**		
CENTRAL BELT	*Observed n*	*Affected n*	*CPR %*	*M*	*F*
Cribra orbitalia					
Farmstead	330	18	5.5	13	5
Funerary	166	10	6.0	4	6
Industry	11	0	0		
Port	13	0	0		
Roadside	145	17	11.7	9	8
Villa	79	3	3.8	1	2
Village	30	1	3.3		1
Total	**774**	**49**	**6.3**	**27**	**22**
Porotic hyperostosis					
Farmstead	330	6	1.8	5	
Funerary	166	0			
Industry	11	0			
Port	13	0			
Roadside	145	6	4.1	3	2
Villa	79	0			
Village	30	0			
Total	**774**	**12**	**1.6**	**9**	**2**

TABLE 7.5: ADULT CRUDE PREVALENCE RATES OF ENAMEL HYPOPLASIA
% of settlement type total

EAST	*Observed n*	*Affected n*	*CPR %*	*M*	*F*
Farmstead	116	1	0.9		1
Funerary	32	0	0		
Roadside	67	2	3.0		1
Villa	19	9	47.4	6	3
Village	4	1	25.0	1	
Total	**238**	**13**	**5.5**	**7**	**5**
SOUTH					
Farmstead	101	12	11.9	6	6
Funerary	173	21	12.1	8	11
Religious	9	1	11.1	1	
Roadside	27	2	7.4	2	
Village	78	8	10.3	4	4
Total	**388**	**44**	**11.3**	**21**	**21**
CENTRAL BELT					
Farmstead	330	32	9.7	20	10
Funerary	166	33	19.9	19	14
Industry	11	6	54.5	4	2
Port	13	0	0		
Roadside	145	22	15.2	13	7
Villa	79	1	1.3		1
Village	30	2	6.7		1
Total	**774**	**96**	**12.4**	**56**	**35**

TABLE 7.6: EAST: ADULT CRUDE PREVALENCE RATES OF NON-SPECIFIC INFECTION/INFLAMMATION
% of settlement type total

	Observed n	*Affected n*	*CPR %*	*M*	*F*
Sub-periosteal new bone formation					
Farmstead	116	7	6.0	5	
Funerary	32	0	0		
Roadside	67	3	4.5	1	2
Villa	19	0	0		
Village	4	2	50.0	2	
Total	**238**	**12**	**5.0**	**8**	**2**
Endocranial lesions					
Farmstead	116	2	1.7		
Funerary	32	0	0		
Roadside	67	0	0		
Villa	19	0	0		
Village	4	0	0		
Total	**238**	**2**	**0.8**		
Osteitis					
Farmstead	116	2	1.7	2	
Funerary	32	0	0		
Roadside	67	0	0		
Villa	19	0	0		
Village	4	0	0		
Total	**238**	**2**	**0.8**	**2**	

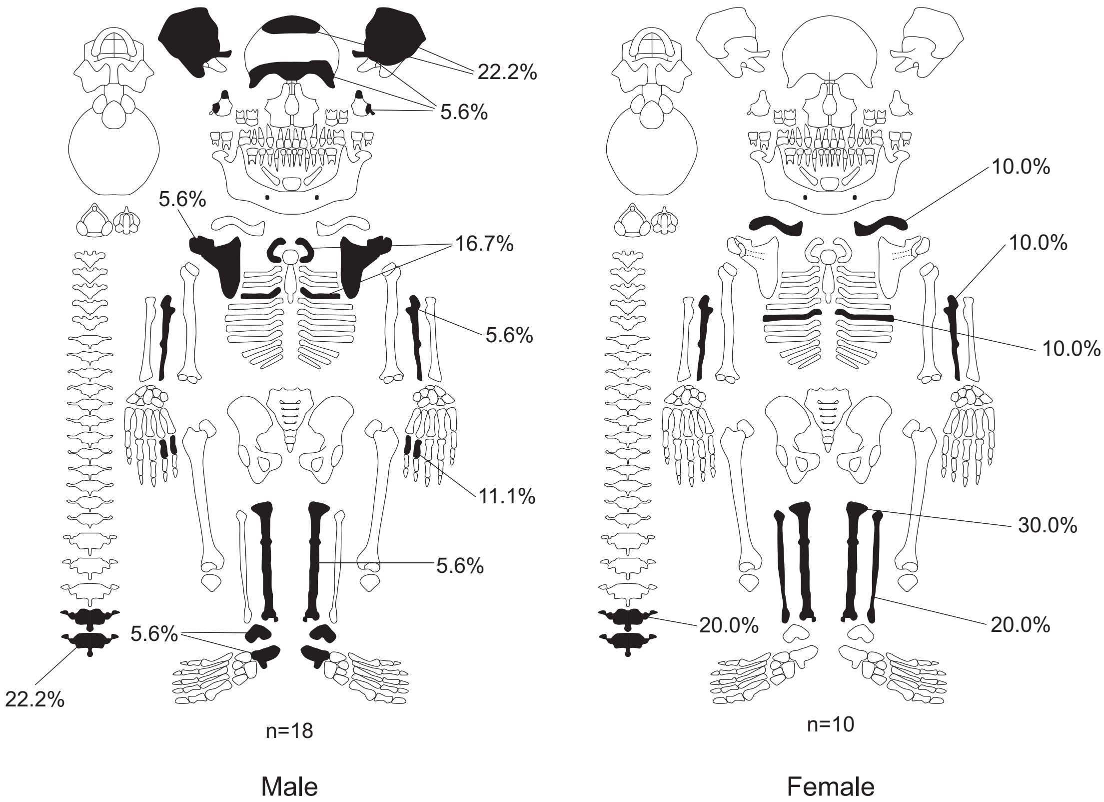

FIG. 7.22. East: elements reported with fractures in adult males and females (per cent of total fractured elements reported)

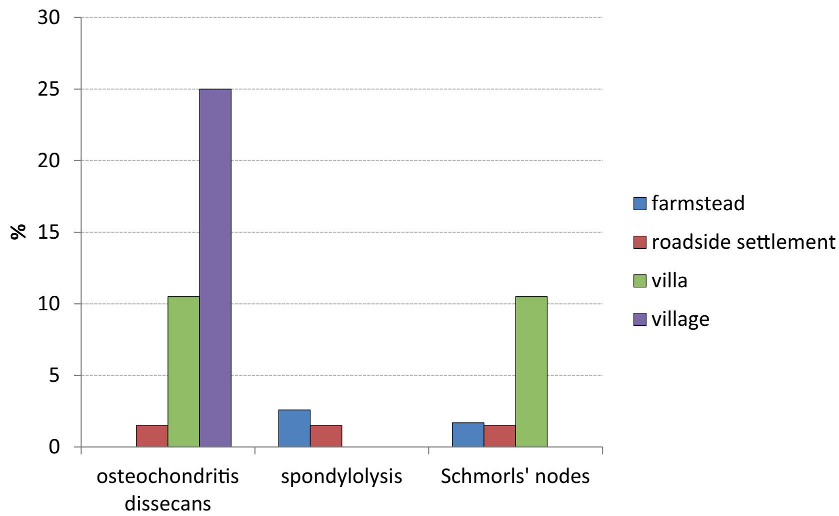

FIG. 7.23. East: crude prevalence rates of joint stress in adults

reported in males (18.1 per cent, n=15) than females (10.3 per cent, n=7) (TABLE 7.8). In the region, 24 individuals (10.1 per cent) were affected, frequently at the spine (20.0 per cent, n=6). This fracture location was also most commonly reported in men (22.2 per cent, n=4) and at complex and unclassified farmsteads (37.5 per cent, n=6). Tibial fractures were most frequent at roadside settlements (28.6 per cent, n=2), Chignal St James villa (33.3 per cent, n=2) and in females (30.0 per cent, n=3) (TABLE 7.9). Sharp force injuries to the cranium, facial region and scapulae were reported in the men (FIG. 7.22).

Joint stress was apparent in the men, the only affected woman being a middle adult female from the complex farmstead at Hutchison Site, Addenbrooke's in Cambridgeshire with spondylolysis. Schmorl's nodes were most prevalent in young adults (8.0 per cent, n=2) and most frequent at Chignal St James villa (10.5 per cent, n=2), whereas OCD in joints of the foot was reported from a range of settlement types.

TABLE 7.7: ADULT CRUDE PREVALENCE RATES OF RESPIRATORY DISEASE
% of settlement type total

EAST	*Observed n*	*Affected n*	*CPR %*	*M*	*F*
Tuberculosis					
Farmstead	116	1	0.9		1
Funerary	32	1	3.1		1
Roadside	67	0	0		
Villa	19	0	0		
Village	4	0	0		
Total	**238**	**2**	**0.8**		**2**
Sinusitis					
Farmstead	116	1	0.9		
Funerary	32	0	0		
Roadside	67	0	0		
Villa	19	0	0		
Village	4	0	0		
Total	**238**	**1**	**0.4**		
Rib periositis					
Farmstead	116	1	0.9	1	
Funerary	32	0	0		
Roadside	67	0	0		
Villa	19	0	0		
Village	4	0	0		
Total	**238**	**1**	**0.4**	**1**	
SOUTH	*Observed n*	*Affected n*	*CPR %*	*M*	*F*
Tuberculosis					
Farmstead	101	1	1.0	1	
Funerary	173	8	4.0	5	3
Religious	9	1	11.1	1	
Roadside	27	0			
Village	78	1	1.3		
Total	**388**	**11**	**2.8**	**7**	**3**
Sinusitis					
Farmstead	101	5	5.0	4	1
Funerary	173	2	1.2	1	1
Religious	9	0			
Roadside	27	0			
Village	78	1	1.3		1
Total	**388**	**8**	**2.0**	**5**	**3**
Rib periostitis					
Farmstead	101	0			
Funerary	173	2	1.2		2
Religious	9	0			
Roadside	27	0			
Village	78	2	2.6	2	
Total	**388**	**4**	**1.0**	**2**	**2**
CENTRAL BELT	*Observed n*	*Affected n*	*CPR %*	*M*	*F*
Tuberculosis					
Farmstead	330	1	0.3		1
Funerary	525	3	0.6	3	
Industry	11	0	0		
Port	13	0	0		
Roadside	145	1	0.7		1
Villa	79	0	0		
Village	30	0	0		
Total	**1133**	**5**	**0.4**	**3**	**2**

TABLE 7.7: (CONT'D)

CENTRAL BELT	*Observed n*	*Affected n*	*CPR %*	*M*	*F*
Sinusitis					
Farmstead	330	4	1.2	3	1
Funerary	525	2	0.4	1	1
Industry	11	0	0		
Port	13	0	0		
Roadside	145	7	4.8	5	2
Villa	79	3	3.8	1	2
Village	30	0	0		
Total	**1133**	**16**	**1.4**	**10**	**6**
Rib periostitis					
Farmstead	330	2	0.6	2	
Funerary	525	4	0.9	2	2
Industry	11	0	0		
Port	13	0	0		
Roadside	145	4	2.8	3	1
Villa	79	0	0		
Village	30	0	0		
Total	**1133**	**10**	**0.9**	**7**	**3**

TABLE 7.8: ADULT CRUDE PREVALENCE RATES OF SKELETAL TRAUMA
% of settlement type total

EAST	*Observed n*	*Affected n*	*CPR %*	*M*	*F*
Farmstead	116	13	11.2	9	2
Funerary	32	0	0		
Roadside	67	5	7.5	3	2
Villa	19	5	26.3	2	3
Village	4	1	25.0	1	
Total	**238**	**24**	**10.1**	**15**	**7**
SOUTH					
Farmstead	101	14	13.9	7	7
Funerary	173	24	13.8	17	7
Religious	9	1	11.1	1	
Roadside	27	1	3.7	1	
Village	78	9	11.5	5	3
Total	**388**	**49**	**12.6**	**31**	**17**
CENTRAL BELT					
Farmstead	330	38	11.5	27	8
Funerary	525	64	12.2	45	19
Industry	11	1	9.1	1	
Port	13	1	7.7	1	
Roadside	145	22	15.2	14	7
Villa	79	10	12.7	6	3
Village	30	3	10.0	3	
Total	**1133**	**139**	**12.3**	**97**	**37**

TABLE 7.9: EAST: TRAUMA LOCATIONS SPECIFIED IN ADULTS, BY SITE TYPE
% of total trauma locations by settlement type

	Farmstead		*Roadside*		*Villa*		*Village*		*Total*	
Element	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Cranium	4	25.0	1	14.3	0		0		5	16.7
Facial	1	6.3	0		0		0		1	3.3
Scapula	1	6.3	0		0		0		1	3.3
Clavicle	0		0		1	16.7	0		1	3.3
Rib	3	18.8	1	14.3	1	16.7	0		5	16.7
Spine	6	37.5	0		0		0		6	20.0
Ulna	1	6.3	1	14.3	0		0		2	6.7
Hand phalanx	0		1	14.3	1	16.7	0		2	6.7
Tibia	0		2	28.6	2	33.3	0		4	13.3
Fibula	0		1	14.3	1	16.7	0		2	6.7
Ankle (talus and calcaneus	0		0		0		1	100	1	3.3
Total	**16**		**7**		**6**		**1**		**30**	

TABLE 7.10: EAST: DEGENERATIVE JOINT DISEASE IN ADULTS
% of settlement type total

	Observed n	*Affected n*	*CPR %*	*M*	*F*
Extraspinal					
Sterno-costal					
Farmstead	116	1	0.9	1	
Total sterno-costal	**238**	**1**	**0.4**	**1**	
Spinal					
Vertebral					
Farmstead	116	25	21.6	12	12
Funerary	32	1	3.1	1	
Roadside	67	10	14.9	4	5
Villa	19	1	5.3	1	
Village	4	1	25.0	1	
Total spinal	**238**	**38**	**16.0**	**19**	**17**
Upper body					
Sterno-clavicular					
Village	4	3	75.0	1	1
Total sterno-clavicular	**238**	**3**	**1.3**	**1**	**1**
Acromio-clavicular					
Village	4	3	75.0	3	
Total acromio-clavicular	**238**	**3**	**1.3**	**3**	
Shoulder					
Farmstead	116	6	5.2	3	3
Funerary	32	3	9.4	3	
Village	4	3	75.0	1	1
Total shoulder	**238**	**12**	**5.0**	**7**	**4**
Elbow					
Farmstead	116	2	1.7		2
Roadside	67	1	1.5		1
Village	4	3	75.0	1	1
Total elbow	**238**	**6**	**2.5**	**1**	**4**
Wrist					
Farmstead	116	3	2.6	3	
Village	**4**	**3**	**75.0**	**1**	**1**
Total wrist	**238**	**6**	**2.5**	**4**	**1**
Hand					
Farmstead	116	4	3.4	1	3
Funerary	32	1	3.1	1	

TABLE 7.10: (CONT'D)

	Observed n	*Affected n*	*CPR %*	*M*	*F*
Hand					
Village	4	3	75.0	1	1
Total hand	**238**	**8**	**3.4**	**3**	**4**
Lower body					
Sacro-iliac					
Farmstead	116	1	0.9		1
Roadside	67	2	3.0		2
Village	4	3	75.0	1	1
Total sacro-iliac	**238**	**6**	**2.5**	**1**	**4**
Hip					
Farmstead	116	5	4.3	1	3
Funerary	32	3	9.4	3	
Roadside	67	3	4.5	1	2
Village	4	3	75.0	1	1
Total hip	**238**	**14**	**5.9**	**6**	**6**
Knee					
Farmstead	116	6	5.2	3	3
Village	4	3	75.0	1	1
Total knee	**238**	**9**	**3.8**	**4**	**4**
Ankle					
Farmstead	116	1	0.9	1	
Village	4	3	75.0	1	1
Total ankle	**238**	**4**	**1.7**	**2**	**1**
Foot					
Farmstead	116	5	4.3	3	2
Roadside	67	2	3.0	2	
Village	4	3	75.0	1	1
Total foot	**238**	**10**	**4.2**	**6**	**3**

TABLE 7.11: EAST: ADULT DENTAL DISEASE
% of settlement type total

	Observed n	*Affected n*	*CPR %*	*M*	*F*
Calculus					
Farmstead	80	22	27.5	13	9
Roadside	54	8	14.8	2	5
Village	4	2	50.0	2	
Total calculus	**157**	**32**	**20.4**	**17**	**14**
Caries					
Farmstead	80	13	16.3	7	6
Roadside	54	11	20.4	5	4
Village	4	2	50.0	2	
Total caries	**157**	**26**	**16.6**	**14**	**10**
AMTL					
Farmstead	80	24	30.0	10	14
Roadside	54	9	6.7	5	4
Village	4	2	50.0	2	
Total AMTL	**157**	**35**	**22.3**	**17**	**18**
PAL/abscess					
Farmstead	80	6	7.5	2	4
Roadside	54	6	11.1	5	1
Village	4	2	50.0	2	
Total PAL/abscess	**157**	**14**	**8.9**	**9**	**5**

Spondylolysis was identified in three adults from Cambridgeshire farmsteads (2.6 per cent), and an additional case was reported from the roadside settlement (1.5 per cent) at Braughing, Buntingford Road in Hertfordshire (FIG. 7.23).

Degenerative joint disease was reported in 16.0 per cent (n=4) of young adults, and increased to 64.3 per cent (n=27) in old age, affecting 33.8 per cent (n=23) of females, and 36.1 per cent (n=30) of males overall. By specified joint locations, degeneration occurred most frequently in the spine (16.0 per cent, n=38), followed by the hip (5.9 per cent, n=14) and shoulder (5.0 per cent, n=12). More women showed degeneration of the elbow and sacro-iliac joint (5.9 per cent, n=4/ male: 1.2 per cent, n=1). Similar differences were also apparent in the hand, (female: 5.9 per cent, n=4/male: 3.6 per cent, n=3), hip and knee (female: 5.9 per cent, n=4/males: 4.8 per cent, n=4) (TABLE 7.10).

Dental disease was reported on in 157 individuals (male n=58, female n=54, not sexed n=45) (Table 7.11). Dental disease was consistently highest in the village at RAF Lakenheath, owing to small sample size, with two of four adults reported with dental disease. Calculus (27.5 per cent, n=22) and AMTL (30.0 per cent, n=24) were more prevalent at farmsteads, comprising Babraham (n=10) and Hutchison site, Addenbrooke's (n=12) in Cambridgeshire, and Melford Meadows, Brettenham, Thetford, in Norfolk (n=2). Proportionately more individuals with caries (20.4 per cent, n=11) and abscesses (11.1 per cent, n=6) were reported from roadside settlements. Prevalence rates for caries, AMTL and abscesses increase from young to old adults, with calculus most prevalent in middle adults (29.3 per cent, n=12). The rates for calculus (male: 29.3 per cent, n=17/female: 25.9 per cent, n=14), caries (male: 24.1 per cent, n=14/female: 18.5 per cent, n=10) and abscesses/PAL (male: 15.5 per cent, n=9/female: 9.3 per cent, n=5) are higher for males, whereas AMTL was reported more frequently in females (female: 33.3 per cent, n=18/male: 29.3 per cent, n=17).

Adult palaeopathology in the South

Haematopoietic lesions were reported in 40 individuals (CO: 9.3 per cent, n=36; PH: 1.0 per cent, n=4). Cribra orbitalia was most prevalent in funerary sites (11.6 per cent, n=20), and porotic hyperostosis in villages (2.6 per cent, n=2) (TABLE 7.4). Both CO and PH were more frequent in females (CO: 17.9 per cent, n=19; PH: 1.9 per cent, n=2). CO was highest in old adults (14.4 per cent, n=13), whereas PH was most prevalent in young adults (1.7 per cent, n=1). Enamel hypoplasia and new bone formation were reported in 44 adults (11.3 per cent). EH were most prevalent in young adults (23.3 per cent, n=14) and at funerary sites (12.2 per cent, n=21), and proportionately more women (14.7 per cent, n=21) exhibited hypoplastic lesions than men (12.8 per cent, n=21) (TABLE 7.5). In comparison to the non-adults, significantly more adults were reported with enamel hypoplasia (non-adult CPR 4.8 per cent, n=15/adult CPR 11.3 per cent, n=44; X^2=9.88, p<0.005, d.f.=1) and cribra orbitalia in the region (non-adult CPR 2.3 per cent, n=8/adult CPR 9.3 per cent, n=36; X^2=16.20, p<0.001, d.f.=1).

New bone formation was most frequently reported in old adults (21.1 per cent, n=19) and farmsteads (12.9 per cent, n=13). These include individuals from unenclosed (n=7), complex (n=4) and unclassified (n=2) farmsteads. Periostitis occurred at similar rates in males and females at 13.4 per cent (n=22) and 13.3 per cent (n=19) respectively. Six adults (1.5 per cent) were reported with endocranial lesions and four (1.1 per cent) with osteomyelitis (TABLE 7.12). Tuberculoid leprosy was described in an old adult male from the funerary site at West Thurrock, Essex, and possible tuberculosis was reported in 2.8 per cent (n=11) of individuals (FIGS 7.21, 7.24). The infectious disease was present in eight individuals (4.6 per cent) from funerary sites, and one adult each from the village site at Zones 6 and 7 of the East Kent Access (1.3 per cent), Springhead Sanctuary complex (11.1 per cent), and the enclosed farmstead at Alington Avenue, Fordington in Dorset (1.0 per cent). Sinusitis affected 2.0 per cent (n=8) of adults, and new bone formation on the pleural aspect of the ribs was reported in four individuals (1.0 per cent). Five of the eight individuals with sinusitis may have developed the condition secondary to a dental abscess (corrected for CPR 0.8 per cent, n=3). Both sinusitis and new bone formation on the ribs tended to be reported in young and middle adults, whereas tuberculosis was most prevalent in old adults (5.6 per cent, n=5). Tuberculosis and sinusitis were more frequent in males (4.3 per cent, n=7/1.2 per cent, n=2), whereas rib periostitis was more frequent in females (1.4 per cent, n=2) (TABLE 7.7).

Examples for metabolic disease were few (n=6, 1.5 per cent). Possible vitamin D and vitamin C deficiency was reported in an old adult male from the funerary context at Zone 19 of the East Kent Access. Healed childhood rickets was present in an old adult male from the funerary site at West Thurrock, Essex. Osteoporosis was reported in old (3.3 per cent, n=3) and middle adult males (0.6 per cent, n=1) from funerary sites.

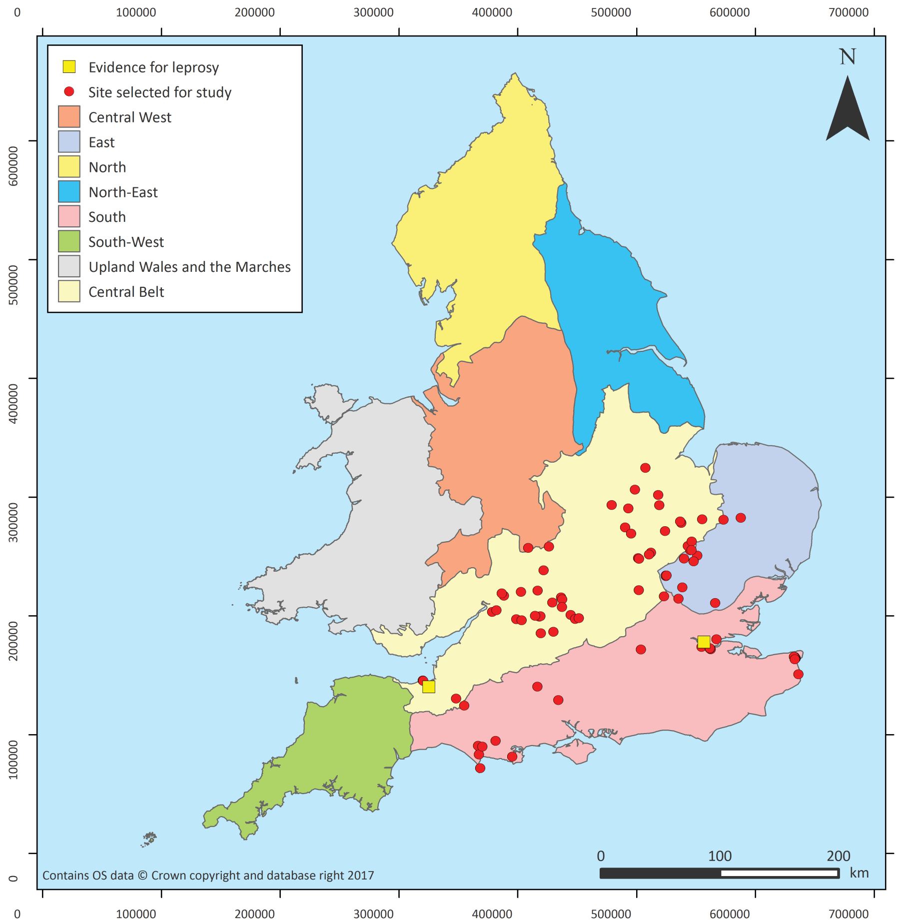

FIG. 7.24. Distributions of sites with reported cases of leprosy

TABLE 7.12: SOUTH: ADULT CRUDE PREVALENCE RATES OF NON-SPECIFIC INFECTION AND INFLAMMATION
% of settlement type total

	Observed n	*Affected n*	*CPR %*	*M*	*F*
Sub-periosteal new bone formation					
Farmstead	101	13	12.9	7	5
Funerary	173	19	11.0	11	8
Religious	9	1	11.1	1	
Roadside	27	3	11.1	2	
Village	78	8	10.3	1	6
Total	**388**	**44**	**11.3**	**22**	**19**
Endocranial lesions					
Farmstead	101	0	0		
Funerary	173	4	2.3	3	2
Religious	9	0	0		
Roadside	27	0	0		
Village	78	1	1.3		1
Total	**388**	**6**	**1.5**	**3**	**3**
Osteomyelitis					
Farmstead	101	4	4.0	2	1
Funerary	173	0	0		
Religious	9	0	0		
Roadside	27	0	0		
Village	78	0	0		
Total	**388**	**4**	**1.1**	**2**	**1**

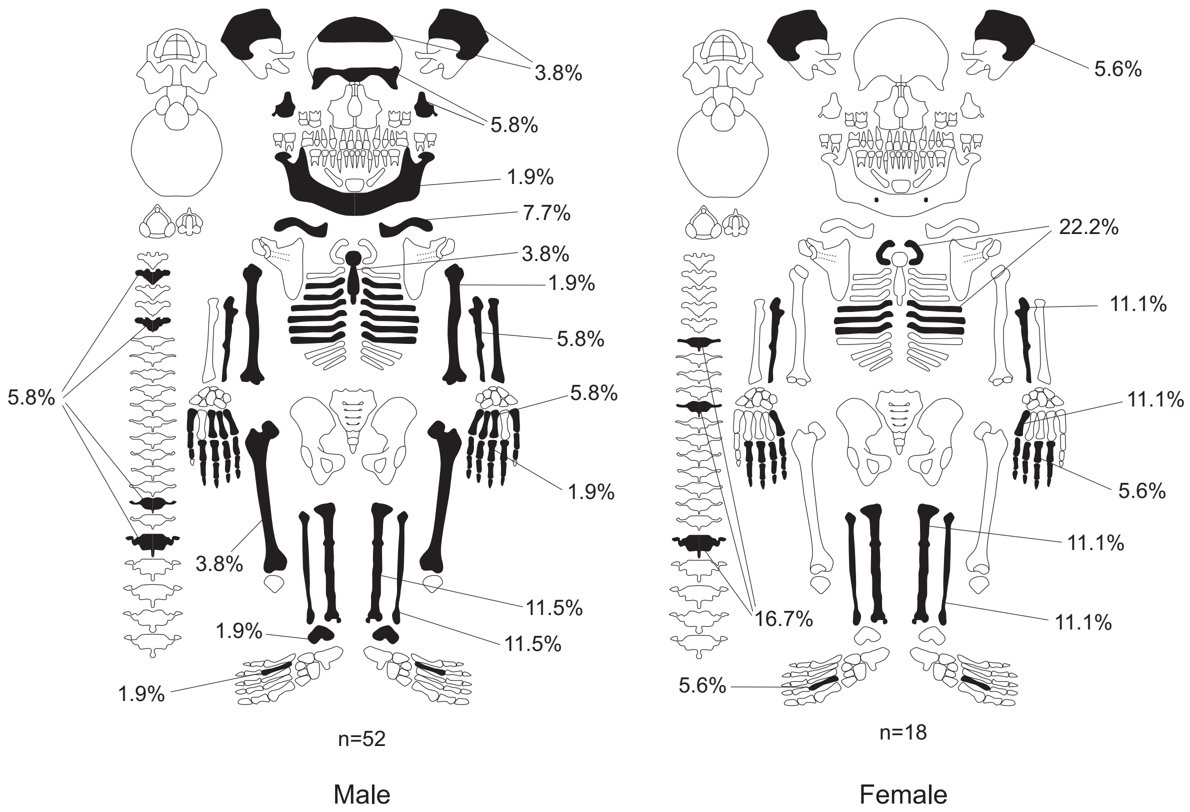

FIG. 7.25. South: elements reported with fractures in adult males and females (per cent of total fractures elements reported)

Trauma was reported in 49 (12.6 per cent) individuals, 18.9 per cent (n=31) of men, and 11.9 per cent (n=17) of women (TABLE 7.8). Overall, ribs were most commonly broken (24.3 per cent, n=17), a pattern also apparent between the sexes and at the settlement level, although fractured fibulae were most common at villages (40.0 per cent, n=4) (TABLE 7.13). Only one old adult female from the complex farmstead at East Kent Access Zones 9 and 10 was presented with multiple trauma of the spine and ribs, whereas multiple trauma affected 11 males. Women had higher rates of spinal fractures (16.7 per cent, n=3) and trauma affecting the forearm, hands and feet. Facial trauma was reported in males only (7.7 per cent, n=4) (FIG. 7.25). Notable cases include the published case of amputation at the humeral mid-shaft in an old adult male from Alington Avenue, Dorset (Waldron 1989), and weapon trauma in a middle adult and four old adult males.

Osteochondritis dissecans in the feet and ankles was reported in 1.8 per cent (n=7), at funerary sites and Springhead Sanctuary complex only, mostly in young adults (6.7 per cent, n=4). OCD was reported in five males (3.0 per cent), as opposed to one female (0.7 per cent). Spondylolysis affected 2.8 per cent (n=11) of adults in the region, mostly at funerary sites (4.0 per cent, n=7). The condition affected more males (4.9 per cent, n=8) than females (2.1 per cent, n=3) and was most common in middle adults (4.6 per cent, n=8). Schmorl's nodes were recorded in 11.9 per cent (n=46) of individuals, 15.9 per cent (n=26) of males and 14.0 per cent (n=20) of females. The distribution of lesions varies slightly according to age and settlement type, where crude prevalence was highest at funerary sites (16.2 per cent, n=28) and in middle adults (14.5 per cent, n=25) (FIG. 7.26).

Degenerative joint disease was reported in 141 individuals (36.3 per cent), in young adults at 10.0 per cent (n=6), and 64.4 per cent (n=58) in old adults. Joint degeneration affected 42.7 per cent (n=61) of females, and 45.7 per cent (n=75) of males. Degenerative changes were most frequently recorded in the spine (27.6 per cent, n=107), followed by the hip (9.3 per cent, n=36) and shoulder (8.8 per cent, n=34). In villages, 50.0 per cent (n=10) of females had evidence for joint disease, as opposed to 30.8 per cent (n=8) of males. More females exhibited joint disease of the shoulder (11.2 per cent, n=16/male: 10.4 per cent, n=17), acromio-clavicular (7.0 per cent, n=10/ male: 3.7 per cent, n=6), and sterno-clavicular joints (4.9 per cent, n=7/male: n=0). Between the sexes, the distribution for the sterno-clavicular joint is statistically significant (X^2=8.22, p<0.005, d.f.=1) (TABLE 7.14).

TABLE 7.13: SOUTH: TRAUMA LOCATIONS SPECIFIED IN ADULTS, BY SITE TYPE
% of total trauma locations by settlement type

	Farmstead		*Funerary*		*Religious*		*Roadside*		*Village*		*Total*	
Element	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Cranium	0		2	5.6	1	33.3	0		0		3	4.3
Mandible	0		1	2.8								
Facial	2	10.0	1	2.8	0		0		0		4	5.7
Clavicle	0		3	8.3	0		0		1	10.0	4	5.7
Sternum	1	5.0	1	2.8	0		0		0		2	2.9
Rib	7	35.0	7	19.4	1	33.3	0		2	20.0	17	24.3
Spine	2	10.0	4	11.1	0		0		0		6	8.6
Humerus	0		1	2.8	0		0		0		1	1.4
Ulna	0		4	11.1	0		1	100	0		5	7.1
Metacarpal	2	10.0	3	8.3	0		0		0		5	7.1
Hand phalanx	1	5.0	1	2.8	0		0		0		2	2.9
Femur	1	5.0	1	2.8	0		0		0		2	2.9
Tibia	2	10.0	3	8.3	1	33.3	0		2	20.0	8	11.4
Fibula	2	10.0	2	5.6	0		0		4	40.0	8	11.4
Ankle (Talus)	0		1	2.8	0		0		0		1	1.4
Metatarsal	0		1	2.8	0		0		1	10.0	2	2.9
Total	**20**		**36**		**3**		**1**		**10**		**70**	

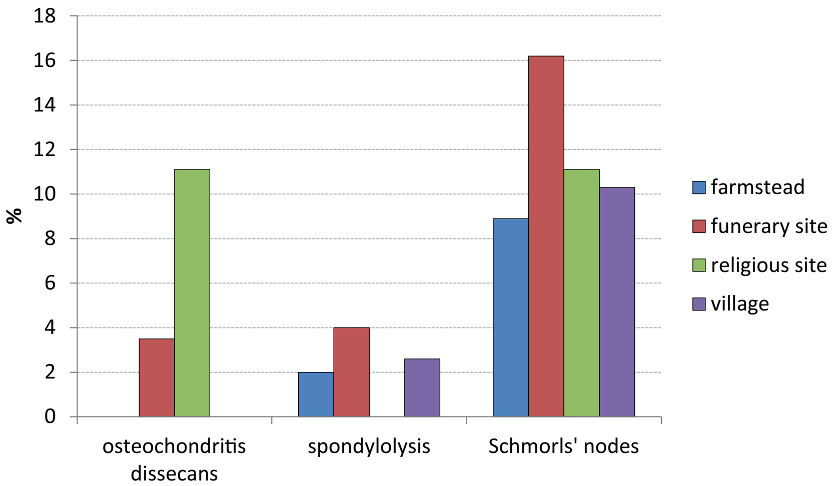

FIG. 7.26. South: crude prevalence rates of joint stress in adults

Dental disease was reported on in 289 individuals (male n=133, female n=106, not sexed n=50) and calculus and caries affected over 30 per cent of adults. AMTL was seen in 29.8 per cent (n=86) of individuals, and 17.6 per cent (n=51) suffered from an abscess or periapical lesion. Calculus was most frequent in young adults (48.9 per cent, n=22), whereas caries, AMTL, abscesses/PAL increase with age. The lowest rate for calculus was observed in farmsteads (23.1 per cent, n=18; complex n=10, unenclosed n=6, unclassified n=2), compared to 41.8 per cent (n=51) at funerary sites. Caries most frequently affected individuals from Springhead Sanctuary complex (55.6 per cent, n=5), and was lowest in roadside settlements (7.4 per cent, n=2). AMTL was least prevalent in adults from roadside settlements (7.4 per cent, n=2), compared to 37.7 per cent (n=46) at funerary sites. At Springhead Sanctuary complex, 22.2 per cent (n=2) of adults had dental abscesses/PAL. Both calculus and caries were more frequent in females at rates of 41.5 per cent (n=44) and 47.2 per cent (n=50), compared to 36.1 per cent (n=48) and 36.8 per cent (n=49) in males (TABLE 7.15).

DISH (diffuse idiopathic skeletal hyperostosis) was reported in two old adult males from contexts along the East Kent Access. One relates to the early to mid-Roman complex farmstead at Zones 9 and 10, and the other to the early Roman

TABLE 7.14: SOUTH: DEGENERATIVE JOINT DISEASE IN ADULTS
% of settlement type total

	Observed n	*Affected n*	*%*	*M*	*F*
Extraspinal					
TMJ					
Farmstead	101	5	5	1	4
Funerary	173	7	4	5	2
Roadside	27	1	3.7	1	0
Village	78	1	1.3	0	1
Total TMJ	**388**	**14**	**3.6**	**7**	**7**
Sterno-costal					
Farmstead	101	7	6.7	6	1
Funerary	173	14	8.1	5	9
Religious	9	1	11.1	1	0
Village	78	5	6.4	3	1
Total sterno-costal	**388**	**27**	**7.0**	**15**	**11**
Spinal					
Vertebral					
Farmstead	101	32	31.7	20	12
Funerary	173	58	33.5	29	28
Religious	9	1	11.1	1	0
Roadside	27	2	7.4	2	0
Village	78	14	17.9	7	6
Total spinal	**388**	**107**	**27.6**	**59**	**46**
Upper body					
Sterno-clavicular					
Farmstead	101	6	5.9	0	6
Funerary	**173**	**1**	**0.6**	**0**	**1**
Total sterno-clavicular	**388**	**7**	**1.8**	**0**	**7**
Acromio-clavicular					
Farmstead	101	7	6.9	1	6
Funerary	**173**	**9**	**5.2**	**5**	**4**
Total acromio-clavicular	**388**	**16**	**4.1**	**6**	**10**
Shoulder					
Farmstead	101	18	17.8	9	8
Funerary	173	13	7.5	6	7
Religious	9	1	11.1	1	0
Roadside	27	1	3.7	1	0
Village	78	1	1.3	0	1
Total shoulder	**388**	**34**	**8.8**	**17**	**16**
Elbow					
Farmstead	101	8	7.9	5	3
Funerary	173	4	2.3	3	1
Village	78	3	3.8	1	2
Total Elbow	**388**	**15**	**3.9**	**9**	**6**
Wrist					
Farmstead	101	6	5.9	3	3
Funerary	173	6	3.5	6	0
Religious	9	1	11.1	1	0
Total wrist	**388**	**13**	**3.4**	**10**	**3**
Hand					
Farmstead	101	13	12.9	9	4
Funerary	173	7	4.0	4	3
Religious	9	1	11.1	1	0
Roadside	27	1	3.7	1	0
Village	78	4	5.1	1	1
Total hand	**388**	**26**	**6.7**	**16**	**8**

TABLE 7.14: (CONT'D)

	Observed n	*Affected n*	*%*	*M*	*F*
Sacro-iliac					
Farmstead	101	11	10.9	6	5
Funerary	173	1	0.6	0	1
Total sacro-iliac	**388**	**12**	**3.1**	**6**	**6**
Hip					
Farmstead	101	20	19.8	11	8
Funerary	173	10	5.8	8	2
Religious	9	1	11.1	1	0
Roadside	27	2	7.4	2	0
Village	78	3	3.8	2	0
Total hip	**388**	**36**	**9.3**	**24**	**10**
Knee					
Farmstead	101	9	8.9	5	4
Funerary	173	7	4.0	6	1
Religious	9	1	11.1	1	0
Roadside	27	1	3.7	1	0
Village	78	9	11.5	4	4
Total knee	**388**	**27**	**7.0**	**17**	**9**
Ankle					
Farmstead	101	5	5.0	4	1
Roadside	27	1	3.7	1	0
Village	78				
Total ankle	**388**	**6**	**1.5**	**5**	**1**
Foot					
Farmstead	101	9	8.9	6	3
Funerary	173	8	4.6	4	4
Religious	9	1	11.1	1	0
Roadside	27	1	3.7	1	0
Village	78	2	2.6	1	1
Total foot	**388**	**21**	**5.4**	**13**	**8**

FIG. 7.27. Central Belt: crude prevalence rates of enamel hypoplasia in adults

TABLE 7.15: SOUTH: DENTAL DISEASE IN ADULTS
% of settlement type total

	Observed n	*Affected n*	*CPR %*	*M*	*F*
Calculus					
Farmstead	78	18	23.1	9	9
Funerary	122	51	41.8	21	26
Religious	9	3	33.3	3	0
Roadside	27	11	40.7	6	4
Village	53	14	26.4	9	5
Total calculus	**289**	**97**	**33.6**	**48**	**44**
Caries					
Farmstead	78	26	33.3	14	13
Funerary	122	54	44.3	24	26
Religious	9	5	55.6	4	1
Roadside	27	2	7.4	1	0
Village	53	17	32.1	6	11
Total caries	**289**	**104**	**36.0**	**49**	**50**
AMTL					
Farmstead	78	26	33.3	14	12
Funerary	122	46	37.7	27	19
Religious	9	1	11.1	1	0
Roadside	27	2	7.4	2	0
Village	53	11	20.8	5	5
Total N AMTL	**289**	**86**	**29.8**	**49**	**36**
Abscess/PAL					
Farmstead	78	17	21.8	9	8
Funerary	122	25	20.5	15	10
Religious	9	2	22.2	2	0
Roadside	27	0	0	0	0
Village	53	7	13.2	3	4
Total abscess/PAL	**289**	**51**	**17.6**	**29**	**22**

funerary site at Zone 19. The condition is characterised by ligament ossification of the spine leading to ankylosis (Ortner 2003).

Adult palaeopathology in the Central Belt

Porotic hyperostosis was only reported in the adults from roadside settlements (4.1 per cent, n=6) and complex, enclosed and unclassified farmsteads (1.8 per cent, n=6). Cribra orbitalia was most frequent in young adults (8.7 per cent, n=10), and was reported at similar rates for males (8.4 per cent, n=27) and females (8.6 per cent, n=22). The highest relative frequency of 11.7 per cent (n=17) was reported for roadside settlements, whereas no lesions were reported from either the industry/villa site at Priors Hall, Weldon, Northamptonshire, or the inland port at Camp Ground, Colne Fen in Cambridgeshire (TABLE 7.4). Enamel hypoplasia affected 12.4 per cent (n=96) of adults, with the statistically highest prevalence reported from the industry/villa site at Priors Hall, Weldon (54.5 per cent, n=6; X^2=43.19, p<0.001, d.f.=6) (FIG. 7.27). Enamel lesions were slightly more prevalent in males (17.4 per cent, n=56) than females (13.7 per cent, n=35) and in old adults (18.8 per cent, n=36), compared to younger individuals (TABLE 7.5). In comparison to the non-adults, proportionately more adults were reported with enamel hypoplasia (non-adult CPR 7.5 per cent/adult CPR 12.4 per cent). Cribra orbitalia was slightly more frequent among the non-adults (non-adult CPR 7.7 per cent/adult CPR 6.3 per cent).

Relative frequencies of osteitis (0.3 per cent, n=3), osteomyelitis (0.8 per cent, n=9) and endocranial lesions (0.7 per cent, n=8) were low. New bone formation was reported in 69 (6.1 per cent) individuals, and most prevalent at the inland port at Camp Ground, Colne Fen (23.1 per cent, n=3) and roadside settlements (13.1 per cent, n=19), which is statistically significant (X^2=24.71, p<0.001, d.f.=6) (TABLE 7.16). New bone formation was most frequent in old adults at 8.4 per cent (n=21) and statistically more prevalent in males (9.9 per cent, n=44) than females (4.5 per cent,

TABLE 7.16: CENTRAL BELT: ADULT CRUDE PREVALENCE RATES OF NON-SPECIFIC INFECTION/INFLAMMATION
% of settlement type total

	Observed n	*Affected n*	*CPR %*	*M*	*F*
Sub-periosteal new bone formation					
Farmstead	330	20	6.1	11	5
Funerary	525	25	4.8	17	8
Industry	11	1	9.1	1	
Port	13	3	23.1	2	1
Roadside	145	19	13.1	12	6
Villa	79	1	1.3	1	
Village	30	0	0		
Total	**1133**	**69**	**6.1**	**44**	**20**
Endocranial lesions					
Farmstead	330	4	1.2	4	
Funerary	525	2	0.4	1	1
Industry	11	0	0		
Port	13	0	0		
Roadside	145	2	1.4	1	1
Villa	79	0	0		
Village	30	0	0		
Total	**1133**	**8**	**0.7**	**6**	**2**
Osteitis					
Farmstead	330	1	0.3		1
Funerary	525	0	0		
Industry	11	0	0		
Port	13	0	0		
Roadside	145	1	0.7		1
Villa	79	1	1.3		1
Village	30	0	0		
Total	**1133**	**3**	**0.3**		**3**
Osteomyelitis					
Farmstead	330	4	1.2	1	3
Funerary	525	2	0.4	2	
Industry	11	0	0		
Port	13	0	0		
Roadside	145	1	0.7	1	
Villa	79	2	2.5	1	1
Village	30	0	0		
Total	**1133**	**9**	**0.8**	**5**	**4**

n=20; X^2=9.49, p<0.005, d.f.=1). Leprosy affected two middle adult males and a young adult female from the funerary site at Cannington, Somerset (FIG. 7.24). Tuberculosis was reported in 0.4 per cent (n=5) of the sample, reported in two males from the funerary site at Cannington, a young adult male from the funerary site at Shakenoak Farm, Oxfordshire, and two old adult females from the unclassified farmstead at Milton, East Waste, Cambridgeshire, and the roadside settlement at Higham Ferrers in Northamptonshire (FIG. 7.21). A total of 10 (0.9 per cent) adults presented with rib periostitis, and 16 (n=1.4 per cent) with sinusitis. Roadside settlements (4.8 per cent, n=7) and villas (3.8 per cent, n=3), showed significantly higher prevalence of sinusitis compared to other settlement types (X^2=24.08, p<0.001, d.f.=6) (TABLE 7.7).

Only a few individuals were reported with metabolic disease, i.e. vitamin D (0.4 per cent, n=5) and vitamin C deficiency (0.3 per cent, n=3). Three cases of healed rickets were reported from the funerary sites at Cannington (n=2) and Horcott Quarry, Gloucestershire (n=1), whereas possible osteomalacia was reported in two individuals described as elderly from Cannington and the villa at Frocester Court, Gloucestershire. Probable and possible vitamin C deficiency affected an elderly individual from the same site, and both a young and old adult male from the roadside settlement at Bourton-on-the-Water, Gloucestershire. Osteoporosis was more frequent

TABLE 7.17: CENTRAL BELT: ADULT CRUDE PREVALENCE RATES OF METABOLIC DISEASE
% of settlement type total

	Observed n	*Affected n*	*CPR %*	*M*	*F*
Vitamin D deficiency					
Farmstead	330	0	0		
Funerary	525	4	0.8	2	1
Industry	11	0	0		
Port	13	0	0		
Roadside	145	0	0		
Villa	79	1	1.3		1
Village	30	0	0		
Total	**1133**	**5**	**0.4**	**2**	**2**
Vitamin C deficiency					
Farmstead	330	0	0		
Funerary	525	1	0.2		
Industry	11	0	0		
Port	13	0	0		
Roadside	145	2	1.4	2	
Villa	79	0	0		
Village	30	0	0		
Total	**1133**	**3**	**0.3**	**2**	
Osteoporosis					
Farmstead	330	2	1.5		1
Funerary	525	2	0.4	1	1
Industry	11	0	0		
Port	13	0	0		
Roadside	145	2	1.4		2
Villa	79	0	0		
Village	30	0	0		
Total	**1133**	**6**	**0.5**	**1**	**4**

in females (0.9 per cent, n=4), than males (0.2 per cent, n=1), and affected 1.6 per cent (n=4) of old adults (TABLE 7.17).

Trauma was reported in 139 individuals (12.3 per cent). Rates were highest in roadside settlements (15.2 per cent, n=22) and lowest at the single port site (5.0 per cent, n=1) (TABLE 7.7). Trauma was most frequent in old adults (23.7 per cent, n=59), and statistically more prevalent in men (21.8 per cent, n=97; X^2=31.03, p<0.001, d.f.=1). Ribs were the most common fracture from sites overall (17.6 per cent, n=35), and also in men (19.0 per cent, n=28). However, spinal trauma was most common in women (17.0 per cent, n=8) and on roadside settlements (18.9 per cent, n=7). Sharp and blunt force trauma indicative of weapon injury to the ulna was reported in a middle adult female from the villa at Frocester Court, Gloucestershire. A middle adult male was reported with a cut at the knee from the same site. At Asthall roadside settlement in Oxfordshire, a possible blade injury to the sixth and seventh cervical vertebra was reported in a middle adult male. Facial trauma affected males and females at similar frequencies of 4.8 per cent (n=7) and 4.3 per cent (n=2) respectively (FIG 7.28). Weapon injury to facial and cranial bones was reported in four males from the village at Gill Mill, Ducklington, Oxfordshire, the funerary sites at Cannington, Somerset, and Horcott Quarry, Gloucestershire, and the roadside settlement at Bourton-on-the-Water, Gloucestershire. Amputation of two hand phalanges was reported in old adult males from a funerary site at Horcott Quarry, Gloucestershire (TABLE 7.18).

Osteochondritis dissecans in the knee, elbow, wrist or ankle joints was reported in fifteen (1.3 per cent) individuals. The condition was more prevalent in middle adults (1.8 per cent, n=7), males (1.8 per cent, n=8) and at roadside settlements (4.1 per cent (n=6). Spondylolysis was reported in 1.1 per cent (n=13) of adults, and was more frequent in females (1.6 per cent, n=7) and at funerary sites (1.7 per cent, n=9). Only a single case of a clay shoveller's fracture was identified, in an old adult male from the funerary site at Horcott Quarry. Schmorl's nodes were recorded in 8.1 per cent (n=92) of adults, and most common in

TABLE 7.18: CENTRAL BELT: TRAUMA LOCATIONS SPECIFIED IN ADULTS, BY SITE TYPE
% of total trauma locations by settlement type

	Farmstead		*Funerary*		*Industry*		*Port*		*Roadside*		*Villa*		*Village*		*Total*	
Element	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Cranium	0		3	3.2	0		0		4	10.8	0		1	33.3	8	4
Mandible	0		2	2.1	0		0		0		0		0		2	1
Facial	2	3.9	5	5.3	0		0		1	2.7	1	9.1	0		9	4.5
Scapula	1	2.0	4	4.2	0		0		0		0		0		5	2.5
Clavicle	2	3.9	8	8.4	0		1	100	2	5.4	0		0		13	6.5
Sternum	0		1	1.1	0		0		0		0		0		1	0.5
Rib	10	19.6	20	21.1	0		0		2	5.4	2	18.2	1	33.3	35	17.6
Spine	10	19.6	0		0		0		7	18.9	1	9.1	0		18	9
Humerus	1	2.0	6	6.3	0		0		0		0		0		7	3.5
Radius	1	2.0	6	6.3	0		0		1	2.7	1	9.1	0		9	4.5
Ulna	2	3.9	7	7.4	0		0		1	2.7	4	36.4	0		14	7
Metacarpal	4	7.8	2	2.1	0		0		1	2.7	0		0		7	3.5
Hand phalanx	7	13.7	4	4.2	0		0		2	5.4	0		0		13	6.5
Hip	0		1	1.1	0		0		1	2.7	2	18.2	0		4	2
Femur	2	3.9	4	4.2	0		0		1	2.7	0		0		7	3.5
Patella	0		2	2.1	0		0		0		0		0		2	1
Tibia	4	7.8	7	7.4	0		0		5	13.5	0		0		16	8
Fibula	3	5.9	6	6.3	0		0		4	10.8	0		1	33.3	14	7
Ankle (talus, calcaneus)	1	2.0	1	1.1	0		0		2	5.4	0		0		4	2
Metatarsal	1	2.0	3	3.2	0		0		2	5.4	0		0		6	3
Foot phalanx	0		3	3.2	1	100	0		1	2.7	0		0		5	2.5
Total	**51**		**95**		**1**		**1**		**37**		**11**		**3**		**199**	

TABLE 7.19: CENTRAL BELT: DEGENERATIVE JOINT DISEASE IN ADULTS
% of settlement type total

	Observed n	*Affected n*	*CPR %*	*M*	*F*
Extraspinal					
TMJ					
Farmstead	330	5	1.5	5	
Funerary	525	10	1.9	6	4
Port	13	0	0		
Roadside	145	6	4.1	3	3
Total TMJ	**1133**	**21**	**1.9**	**14**	**7**
Sterno-costal					
Farmstead	330	4	1.2	2	2
Funerary	525	4	0.8	4	
Port	13	1	7.7		1
Roadside	145	4	2.8		3
Village	30	1	3.3	1	
Total sterno-costal	**1133**	**14**	**1.2**	**7**	**6**
Spinal					
Vertebral					
Farmstead	330	80	24.2	33	40
Funerary	525	148	28.2	82	62
Industry	11	4	36.4	4	
Port	13	7	53.8	4	3
Roadside	145	51	35.2	24	25
Villa	79	16	20.3	6	9
Village	30	1	3.3	1	
Total spinal	**1133**	**305**	**26.9**	**153**	**138**
Upper body					
Sterno-clavicular					
Farmstead	330	6	1.8	2	4
Funerary	525	4	0.8	4	
Roadside	145	7	4.8	4	3
Total sterno-clavicular	**1133**	**17**	**1.5**	**10**	**7**
Acromio-clavicular					
Farmstead	330	2	0.6	2	
Funerary	525	4	0.8	4	
Roadside	145	15	10.3	6	9
Village	30	1	3.3	1	
Total acromio-clavicular	**1133**	**22**	**1.9**	**13**	**9**
Shoulder					
Farmstead	330	18	5.5	12	4
Funerary	525	22	4.2	10	12
Roadside	145	14	9.7	6	8
Villa	79	3	3.8		3
Total shoulder	**1133**	**57**	**5.0**	**28**	**27**
Elbow					
Farmstead	330	8	2.4	4	4
Funerary	525	21	4.0	14	5
Roadside	145	9	6.2	5	4
Villa	79	5	6.3		5
Village	30	1	3.3	1	
Total elbow	**1133**	**44**	**3.9**	**24**	**18**

TABLE 7.19: (CONT'D)

	Observed n	*Affected n*	*CPR %*	*M*	*F*
Wrist					
Farmstead	330	13	3.9	10	3
Funerary	525	26	5.0	16	10
Port	13	1	7.7		1
Industry	11	1	9.1	1	
Roadside	145	15	10.3	7	8
Villa	79	1	1.3		1
Total wrist	**1133**	**57**	**5.0**	**34**	**23**
Hand					
Farmstead	330	18	5.5	8	8
Funerary	525	23	4.4	10	13
Roadside	145	15	10.3	5	10
Villa	79	5	6.3	1	3
Village	30	1	3.3	1	
Total hand	**1133**	**62**	**5.5**	**25**	**34**
Sacro-iliac					
Farmstead	330	3	0.9	3	
Funerary	525	4	0.8	2	2
Roadside	145	3	2.1		3
Villa	79	1	1.3		
Total sacro-iliac	**1133**	**11**	**1.0**	**5**	**5**
Hip					
Farmstead	330	21	6.4	13	5
Funerary	525	27	5.1	23	4
Port	13	1	7.7	1	
Roadside	145	18	12.4	8	10
Villa	79	7	8.9	2	3
Total hip	**1133**	**74**	**6.5**	**47**	**22**
Knee					
Farmstead	330	8	2.4	7	1
Funerary	525	23	4.4	13	10
Industry	11	2	18.2	2	
Roadside	145	12	8.3	5	7
Villa	79	4	5.1		3
Village	30	2	6.7	2	
Total knee	**1113**	**51**	**4.5**	**29**	**21**
Ankle					
Farmstead	330	4	1.2	3	1
Funerary	525	9	1.7	5	4
Roadside	145	8	5.5	3	4
Villa	79	1	1.3		
Village	30	1	3.3	1	
Total ankle	**1133**	**23**	**2.0**	**12**	**9**
Foot					
Farmstead	330	7	2.1	5	1
Funerary	525	23	4.4	13	10
Port	13	2	15.4	2	
Roadside	145	9	6.2	3	5
Villa	79	1	1.3		
Total foot	**1133**	**42**	**3.7**	**23**	**16**

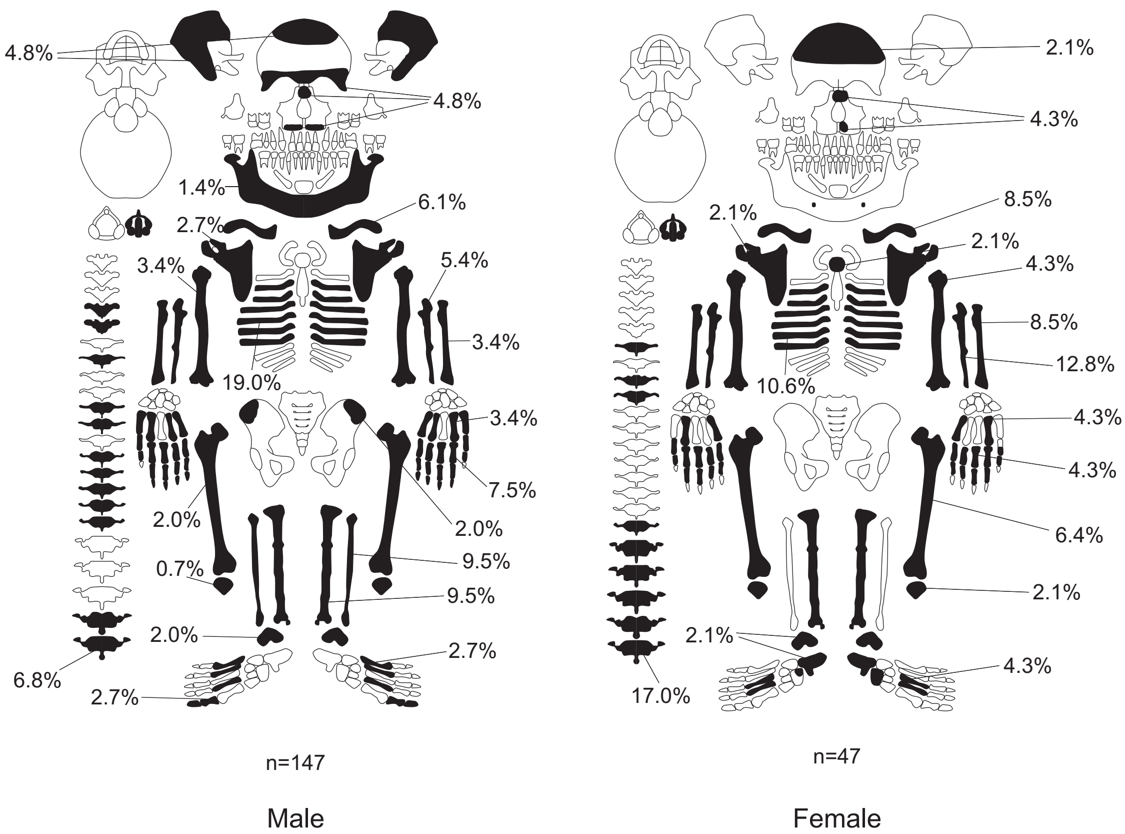

FIG. 7.28. Central Belt: elements reported with fractures in adult males and females (per cent of total fractures elements reported)

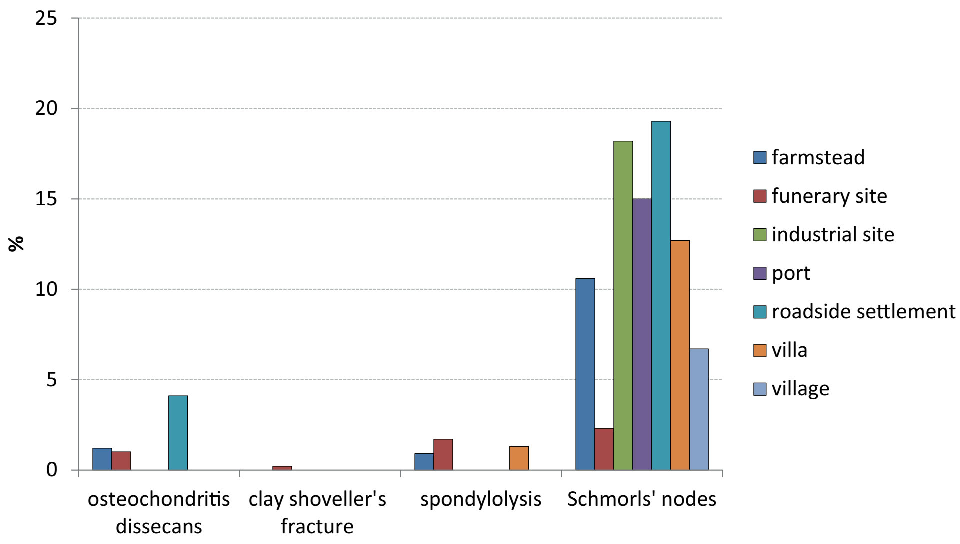

FIG. 7.29. Central Belt: crude prevalence rates of joint stress in adults

middle adults (12.2 per cent, n=48) and males (10.8 per cent, n=48). The inland port at Camp Ground, Colne Fen in Cambridgeshire, has the highest rate of spinal lesions at 23.1 per cent, although only three individuals were affected. Schmorl's nodes were also frequent on roadside settlements (19.3 per cent, n=28) (FIG. 7.29).

Degenerative changes were noted in 400 individuals, 35.5 per cent overall. As expected, joint disease advanced with age, and was most frequent in old adults (67.1 per cent, n=167), although 33.3 per cent (n=5) of young adults at villas are already affected. Significantly fewer women (37.6 per cent, n=166) had joint disease than men (47.2 per cent, n=210; X^2=8.27, p<0.005, d.f.=1). However, 66.7 per cent (n=4) of men and women at the inland port at Camp Ground, Colne Fen, had joint degeneration, and more women (55.6,

TABLE 7.20: CENTRAL BELT: DENTAL DISEASE IN ADULTS
% of settlement type total

	Observed n	*Affected n*	*CPR %*	*M*	*F*
Calculus					
Farmstead	315	104	33.0	52	43
Funerary	166	53	31.9	35	17
Industry	11	4	36.4	4	0
Port	13	4	30.8	3	1
Roadside	145	40	27.6	20	19
Villa	79	17	21.5	3	13
Village	30	4	13.3	2	1
Total calculus	**759**	**226**	**29.8**	**119**	**94**
Caries					
Farmstead	315	106	33.7	57	37
Funerary	166	69	41.6	43	26
Industry	11	6	54.5	4	2
Port	13	2	15.4	2	
Roadside	145	40	27.6	19	19
Villa	79	49	62.0	3	11
Village	30	23	76.7	3	4
Total caries	**759**	**247**	**32.5**	**131**	**99**
AMTL					
Farmstead	315	54	17.1	30	20
Funerary	166	62	37.3	35	27
Industry	11	3	27.3	3	0
Port	13	8	61.5	5	3
Roadside	145	23	15.9	12	11
Villa	79	10	12.7	1	9
Village	30	5	16.7	4	1
Total AMTL	**759**	**165**	**27.8**	**78**	**84**
Abscess/PAL					
Farmstead	315	12	3.8	8	4
Funerary	166	46	27.7	26	20
Industry	11	0	0		
Port	13	1	7.7		1
Roadside	145	15	10.3	6	9
Villa	79	6	7.6	2	6
Village	30	0	0		
Total abscess/PAL	**759**	**80**	**10.5**	**42**	**38**

n=30) from roadside settlements presented with degeneration than men (42.9 per cent, n=27). The spine was the most frequently cited location of joint degeneration (26.9 per cent, n=305), followed by the hip (6.5 per cent, n=74) and hand (5.5 per cent, n=62). This pattern is mimicked at the site level, although the knee joint is most frequently affected at the only village site at Gill Mill, Ducklington, in Oxfordshire (25.0 per cent, n=2). Degeneration in the hand is more frequent in females (7.7 per cent, n=34) than males (5.6 per cent, n=25) (TABLE 7.19).

Dental disease was reported on in 759 adults (male n=314, female n=249, unsexed n=196). Caries was most frequent, affecting 32.5 per cent (n=247) of adults, compared to 10.5 per cent (n=80) for abscesses/PAL. Dental disease became more frequent with advancing age, apart from calculus which was most prevalent in middle adults (43.5 per cent, n=110). Both calculus and caries were slightly more prevalent in men, at 37.9 per cent (n=119) and 41.7 per cent (n=131), compared to rates of 37.8 per cent (n=94) and 39.8 per cent (n=99) in females. Tooth loss and abscesses were, however, more frequently identified in the female cohort at rates of 33.7 per cent (n=84) and 15.3 per cent (n=38). Caries affected significantly more individuals at the industry/villa site at Priors Hall, Weldon, Northamptonshire (54.5 per cent, n=6; X^2=54.03, p<0.001, d.f.=6). Camp Ground, Colne Fen (61.5 per cent, n=8), and funerary sites (37.7 per cent, n=62) showed significantly higher rates of AMTL (X^2=42.83, p<0.001, d.f.=6). Abscesses and periapical lesions were statistically more prevalent at funerary sites, particularly at Horcott Quarry in Gloucestershire and Radley Barrow Hills in Oxfordshire (27.7 per cent, n=46; X^2=80.43, p<0.001, d.f.=6) (TABLE 7.20).

PALAEOPATHOLOGY AND BURIAL ARCHAEOLOGY

Burial practice in rural Roman Britain is discussed in detail in Chapter 6 of this volume. Patterns in the distribution of ages-at-death, sex, and palaeopathology in relation to burial practice are presented below. These are based on the subsample of rural Romano-British inhumation burials outlined above.

Palaeopathology and burial archaeology in the East

The subsample discussed here includes six prone (positioned face down) adult burials from the complex farmsteads (5.2 per cent) at Clay Farm, Trumpington (n=1) and Hutchison site, Addenbrooke's (n=4) in Cambridgeshire, and Melford Meadows, Norfolk (n=1). The practice was apparent in every adult age group (TABLES 7.21 and 7.22). Women were buried prone in 5.9 per cent (n=4) of cases, whereas only one adult

TABLE 7.21: EAST: PALAEOPATHOLOGY SUBSAMPLE OF PRONE AND DECAPITATED BURIALS, AND BURIALS WITH GRAVE GOODS
% of observed total

Prone	*Observed n*	*Affected n*	*%*
Sex			
Adult	238	6	2.5
M	83	1	1.2
F	68	4	5.9
Decapitation	*Observed n*	*Affected n*	*%*
Sex			
Total	322	24	7.5
Non-adult	79	2	2.5
Adult	238	21	8.8
M	83	7	8.4
F	68	9	13.2
Grave goods	*Observed n*	*Affected n*	*%*
Sex			
Total	322	65	20.2
Non-adult	79	11	13.9
Adult	238	53	22.3
M	83	13	15.7
F	68	18	26.5

TABLE 7.22: EAST: PRONE BURIALS BY AGE AND SETTLEMENT TYPE
% of observed total

	Farmstead observed	*affected*	*%*	*Total observed*	*affected*	*%*
18–25	8	1	12.5	25	1	4.0
26–45	21	1	4.8	64	1	1.6
>46	34	2	5.9	42	2	4.8
Adult	53	2	3.8	107	2	1.9
Total n	**116**	**6**	**5.2**	**238**	**6**	**2.5**

TABLE 7.23: EAST: PRONE BURIALS BY AGE AND SETTLEMENT TYPE
% of observed total

	Farmstead observed	*affected*	*%*	*Villa observed*	*affected*	*%*	*Total observed*	*affected*	*%Non-adult*
Non-adult									
10.6–14.5	1	1	100	0			2	1	50.0
14.6–17.0	2	1	50.0	1	0	0	7	1	14.3
Total	**24**	**2**	**8.3**	**5**	**0**	**0**	**79**	**2**	**2.5**
Adult									
18–25	8	1	12.5	3	2	66.7	25	3	12.0
26–45	21	4	19.0	13	3	23.1	64	7	10.9
>46	34	6	17.6	0			42	6	14.3
Adult	53	5	9.4	3	0	0	107	5	4.7
Total	**116**	**16**	**13.8**	**19**	**5**	**26.3**	**238**	**21**	**8.8**

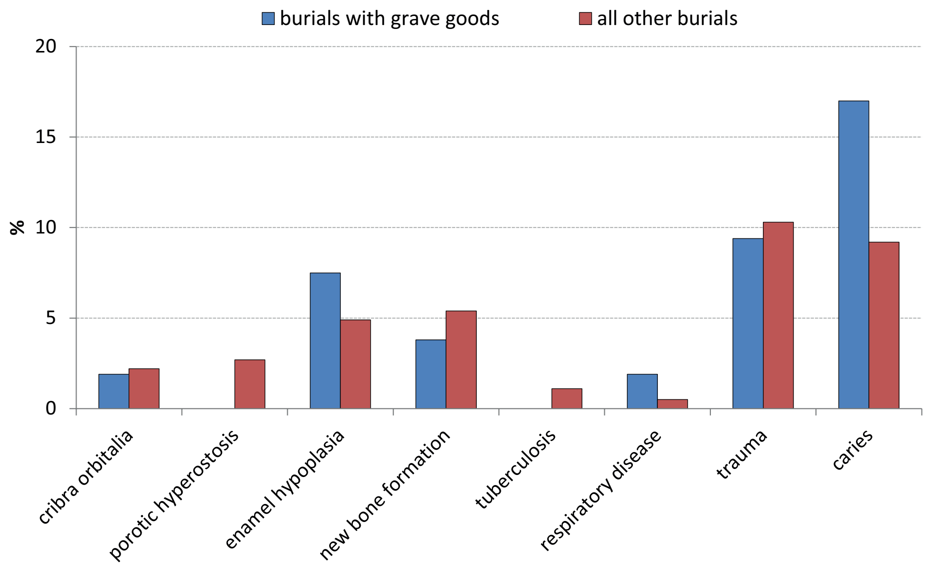

FIG. 7.30. East: crude prevalence rates of palaeopathology in adult inhumations with grave goods

male (1.2 per cent) was interred face down. Palaeopathology in this cohort was low overall, with enamel hypoplasia, caries and joint disease affecting one individual each. Notably, one young adult female was reported with tuberculosis.

A total of 7.5 per cent (n=24) of burials in the sample were of decapitated individuals, 19 from unclassified and complex farmsteads (13.8 per cent) and five from Chignal St James villa (26.3 per cent). These include two older children (2.5 per cent), one unaged individual, and 21 (8.8 per cent) adults. Decapitation was more frequent in adult females (13.2 per cent, n=9) (TABLE 7.22). The rite was most prevalent in children aged 10.6–14.5 years old (50.0 per cent, n=1), although sample sizes are small for this cohort (TABLES 7.21, 7.23). Decapitated adults showed proportionally higher rates of porotic hyperostosis (9.5 per cent, n=2), enamel hypoplasia (19.0 per cent, n=4), respiratory disease (4.8 per cent, n=1) and caries (14.3 per cent n=3), although sample sizes are small.

Grave goods were present in 65 (20.2 per cent) burials. Fewer child burials were furnished (13.9 per cent, n=11), than those of adults (22.3 per cent, n=53). Women (26.5 per cent, n=18) were more often accompanied by grave goods than men (15.7 per cent, n=13) (TABLE 7.21). In non-adults, those buried in furnished graves exhibited higher frequencies of EH, trauma and caries, although each of these cases is represented by only one individual each. In the adults, frequencies of EH (7.5 per cent, n=4), respiratory disease (1.9 per cent, n=1) and caries (17.0 per cent, n=9) were higher in the cohort buried with grave goods (FIG. 7.30). Again, sample sizes are small and may not be representative.

TABLE 7.24: SOUTH: PALAEOPATHOLOGY SUBSAMPLE OF PRONE AND DECAPITATED BURIALS, AND BURIALS WITH GRAVE GOODS
% of observed total

Prone	*Observed n*	*Affected n*	%
Sex			
Total	741	8	1.1
Non-adult	351	2	0.6
Adult	388	6	1.5
M	164	1	0.6
F	143	5	3.5
Decapitation	*Observed n*	*Affected n*	%
Sex			
Total	741	3	0.4
Adult	388	3	0.8
M	164	1	0.6
F	143	2	1.4
Grave goods	*Observed n*	*Affected n*	%
Sex			
Total	741	101	13.6
Non-adult	351	16	4.6
Adult	388	85	21.9
M	164	27	16.5
F	143	43	30.1

Palaeopathology and burial archaeology in the South

A total of eight (1.1 per cent) prone burials were reported, including two 14.6–17.0 year olds and six (1.5 per cent) adults. Prone burial was most frequent in adolescents (18.2 per cent, n=2), and at complex and unenclosed farmsteads (2.6 per cent, n=4). In this subsample, more adult females (3.5 per cent, n=5) were buried face down than males (0.6 per cent, n=1) (TABLES 7.24 and 7.25).

TABLE 7.25: SOUTH: PRONE AND DECAPITATED BURIALS BY AGE AND SETTLEMENT TYPE
% of observed total

	Farmstead			*Funerary*			*Village*			*Total*		
Prone	*observed*	*affected*	*%*	*observed*	*affected*	*%*	*observed*	*affected*	*%*	*n*	*affected*	*%*
14.6–17.0	1	0	0	4	0	0	3	2	66.7	11	2	18.2
18–25	14	1	7.1	27	0	0	11	0	0	60	1	1.7
26–45	42	1	2.4	94	1	1.1	18	0	0	173	2	1.2
>46	29	2	6.9	39	1	2.6	17	0	0	90	3	3.3
Total n	**156**	**4**	**2.6**	**256**	**2**	**0.8**	**114**	**2**	**1.8**	**741**	**8**	**1.1**
Decapitation												
26–45	42	1	2.4	94	0	0	18	0	0	173	1	0.6
>46	29	0	0	39	1	2.6	17	1	5.9	90	2	2.2
Total n	**156**	**1**	**0.6**	**256**	**1**	**0.4**	**114**	**1**	**0.9**	**741**	**3**	**0.4**

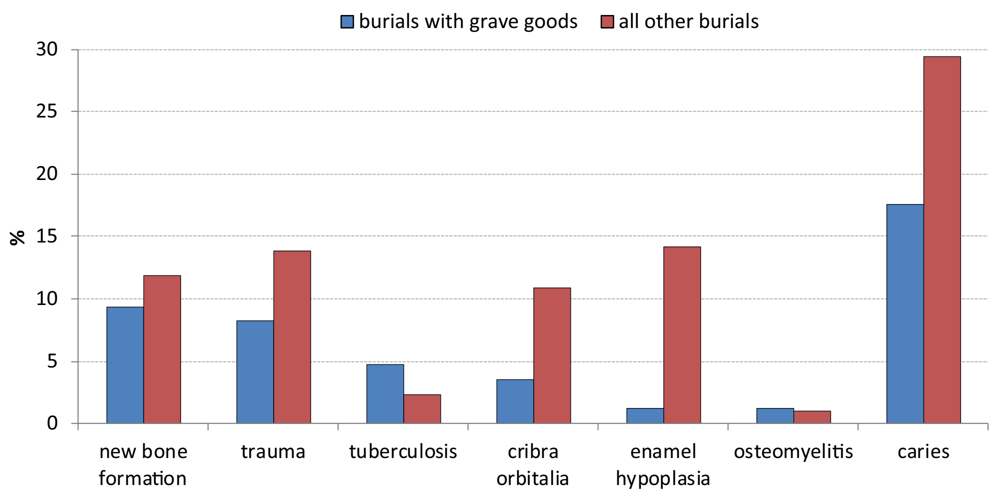

FIG. 7.31. South: crude prevalence rates of palaeopathology in adult inhumations with grave goods

In the adults, frequencies for haematopoietic lesions, enamel defects, new bone formation, bone infections, respiratory disease, TB, metabolic disease, trauma and caries were consistently higher in the prone cohort. However, sample sizes are small.

Three (0.4 per cent) decapitated burials were reported, one each from the complex farmstead at Zones 9 and 10 of the East Kent Access (0.6 per cent), the funerary site at Alington Avenue, Fordington in Dorset (0.4 per cent), and the village at Mucking, Essex (0.9 per cent). Decapitation occurred in adults only (0.8 per cent), and was identified in one male (0.6 per cent) and two females (1.4 per cent) (TABLE 7.24). The highest frequency of this burial rite was observed in old adults (2.2 per cent, n=2) (TABLE 7.25). Palaeopathology is negligible in this sample, with one individual affected by dental disease.

Grave goods were reported in 101 (13.6 per cent) burials. Significantly more adult burials (21.9 per cent, n=85; X^2=47.07, p<0.001, d.f.=1) and female burials (30.1 per cent, n=43; X^2=8.02, p<0.005, d.f.=1) were furnished (TABLE 7.24). Furnishings were most frequent in 18–25 year olds (23.3 per cent, n=14). Both osteomyelitis (1.2 per cent, n=1) and tuberculosis (4.7 per cent, n=4) were more frequent in the adults that were accompanied by goods. Enamel hypoplasia was significantly more frequent in unfurnished burials (14.2 per cent, n=43) than in those with grave goods (1.2 per cent, n=1; X^2=11.78, p<0.001, d.f.=1) (FIG. 7.31).

Palaeopathology and burial archaeology in the Central Belt

A total of 63 individuals (3.8 per cent) were reported prone in the subsample for the Central Belt. Six children were buried prone, compared to 57 adults (5.0 per cent), which is statistically significant (X^2=14.51, p<0.001, d.f.=1). In the children, prevalence was highest in 2.6–6.5 year olds from villas (20.0 per cent, n=1) (TABLES 7.26 and 7.27). Palaeopathology includes one case of dental disease, and Schmorl's nodes in the adolescent from the complex farmstead at Higham

TABLE 7.26: CENTRAL BELT: DISTRIBUTION OF PRONE BURIALS IN NON-ADULT GRAVES
% of observed total

	Farmstead observed	*affected*	*%*	*Funerary* observed	*affected*	*%*	*Villa* observed	*affected*	*%t*
Perinate	17	1	5.6	22	0	0	35	1	2.9
0–1.0	34	0	0	63	1	1.6	29	0	0
1.1–2.5	6	0	0	29	0	0	2	0	0
2.6–6.5	8	0	0	37	0	0	5	1	20.0
6.6–10.5	7	0	0	21	1	4.8	4	0	0
10.6–14.5	6	0	0	26	0	0	3	0	0
14.6–17.0	11	1	9.1	19	0	0	1	0	0
Non-adult	2	0	0	18	0	0	1	0	0
Total n	**91**	**2**	**2.2**	**235**	**2**	**0.9**	**80**	**2**	**2.5**

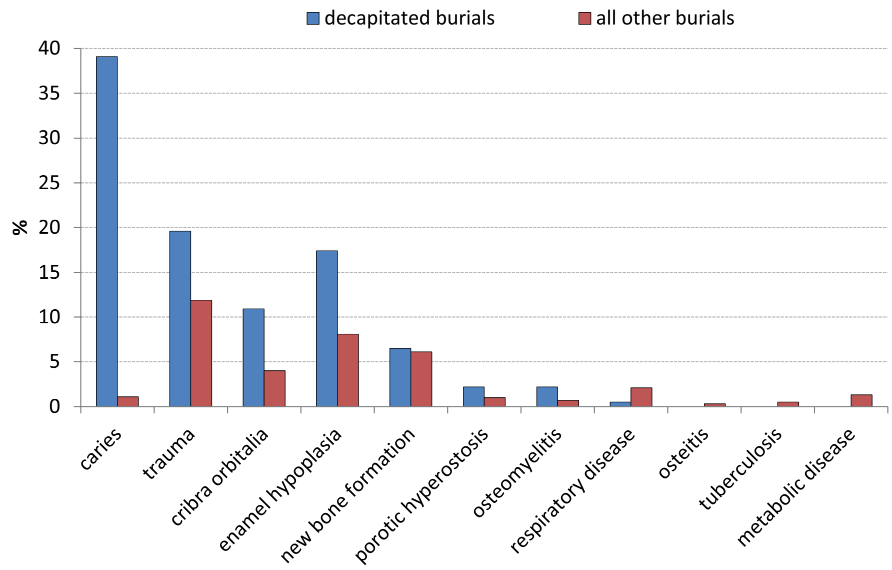

FIG. 7.32. Central Belt: crude prevalence rates of palaeopathology in adult decapitated burials

Road, Burton Latimer in Northamptonshire. In the adults, slightly higher numbers of males were reported prone (6.7 per cent, n=30), and the rite was most frequent in old adults (8.0 per cent, n=20). Sample sizes are small, but it is apparent that lesions are more frequent in adults that were interred face down, particularly for cribra orbitalia (10.5 per cent, n=6/4.0 per cent, n=43), trauma (28.1 per cent, n=16/11.4 per cent, n=123) and caries (36.8 per cent, n=21/21.0 per cent, n=226).

Decapitation was reported in 48 individuals (2.9 per cent). Two children were decapitated (0.4 per cent), including a 6.6–10.5 year old with enamel hypoplasia. Overall, significantly more adults (4.1 per cent, n=46) than children were decapitated (X^2=17.13, p<0.001, d.f.=1). The rite was slightly more frequent among males (4.7 per cent, n=21), and old adults (6.4 per cent, n=16) (TABLE 7.26). Significantly higher rates of enamel hypoplasia (17.4 per cent, n=8; X^2=48.13, p<0.001, d.f.=1), trauma (19.6 per cent, n=9, X^2=96.43, p<0.001, d.f.=1) and caries (39.1 per cent, n=18, X^2=266.40, p<0.001, d.f.=1) were reported in the decapitated adult cohort (FIG. 7.32).

Overall, 11.0 per cent (n=182) of burials were furnished. Grave goods were significantly more frequent in the adult cohort (14.2 per cent, n=161), compared to the children (4.1 per cent, n=21; X^2=36.55, p<0.001, d.f.=1) (TABLE 7.26). No perinates were buried with grave goods. Old adults have the highest frequency of furnished graves at 16.5 per cent (n=41), whereas 6.6–10.5 year olds mark the non-adult group with most furnished graves (12.8 per cent, n=5).

In the non-adults, higher rates for cribra orbitalia (14.3 per cent, n=3/7.4 per cent, n=36), enamel hypoplasia (9.5 per cent, n=2/5.7 per cent, n=28), endocranial lesions (9.5 per cent, n=2/5.7 per cent, n=28), respiratory disease (4.8 per cent, n=1/0.4 per cent, n=2) and caries (4.8 per cent, n=1/2.3 per cent, n=11) were reported in those buried with grave goods. In the adult cohort,

TABLE 7.27: CENTRAL BELT: PALAEOPATHOLOGY SUBSAMPLE OF PRONE AND DECAPITATED BURIALS, AND BURIALS WITH GRAVE GOODS
% of observed total

Prone	*Observed n*	*Affected n*	*%*
Sex			
Total	1654	63	3.8
Non-adult	509	6	1.2
Adult	1133	57	5.0
M	445	30	6.7
F	441	19	4.3
Decapitation	*Observed n*	*Affected n*	*%*
Sex			
Total	1654	48	2.9
Non-adult	509	2	0.4
Adult	1133	46	4.1
M	445	21	4.7
F	441	16	3.6
Grave goods	*Observed n*	*Affected n*	*%*
Sex			
Total	1654	182	11.0
Non-adult	509	21	4.1
Adult	1133	161	14.2
M	445	56	12.6
F	441	74	16.8

pathology rates are similar between furnished and unfurnished inhumation burials. All the adults diagnosed with tuberculosis (0.5 per cent, n=5) were buried without grave goods, although a higher rate of respiratory disease is apparent in furnished graves (3.8 per cent, n=6).

DISCUSSION

The current study marks the first effort in providing a focused analysis of adult and child health in rural Roman Britain. It gives much needed reference points for ages-at-death, sex distributions, and palaeopathology in three regional case studies, the East, South and Central Belt of England. As discussed in Chapter 6, the pre-Roman Iron Age is characterised by a paucity of archaeologically detectable burial rites across much of Britain, and it is likely that a large proportion of rural Roman Britons may have been afforded similar forms of treatment in death. The skeletal data available for the study are, therefore, biased. We observe the biological signatures of only a selected dead population, which may not accurately reflect population size, structure and health in rural Roman Britain (Chamberlain 2001).

Additional limitations arise due to variations in sample sizes, with some settlement types being represented by just one site, and by differences in the recording and reporting of bioarchaeological data. Discrepancies exist between the methods used, particularly with regard to non-adult skeletal remains. However, by consolidating the data into standardised age groups, and discussing crude as opposed to true prevalence rates, we are able to grasp health and wellbeing in the largest sample of men, women and children of the Romano-British countryside to date.

BURIAL RITES AND PALAEOPATHOLOGY

Perinatal and infant burial: distinct rites or evidence for absence?

Extremes in the representation of newborn and infant burials in Romano-British cemeteries are the subject of ongoing debate (see Gilmore and Halcrow 2014). Rates may vary from complete absence of infants and perinates in designated cemetery sites, to burial grounds entirely composed of those who have not survived the first year of life. These trends have previously been noted by Rohnbogner and Lewis (2016a) in an analysis of ages-at-death in urban and rural Romano-British children. In fact, major urban burial grounds held significantly fewer infant burials than those from rural sites. Observations in the current study expand on this, and demonstrate that even within the rural cohort itself, significant variation in the rate of burial and recovery of both infants and perinates exists. Major differences were found in the spatial and temporal distribution of perinate and infant burials across the regions, suggesting fluctuations in biological (i.e. endogenous) and environmental (i.e. exogenous) factors that determine survival at birth and during the first year of life (Bourgeois-Pichat 1951; Vögele 1994; Murray and Frenk 2002). Ill-health of the mother, birth trauma and congenital disease will raise mortality at birth (Frenzen and Hogan 1982), whereas death in infancy is profoundly affected by infection, poisoning, accidents and shortcomings in nutrition (Scott and Duncan 1999). Mortality at birth must have been low in settlements and phases with only very few perinate burials. Accordingly, this would suggest that the risks of congenital diseases, birth trauma and maternal ill-health did not pose a hazard to newborns in early and late Roman periods, at all settlement types in the East except roadside settlements, and at the farmsteads and funerary sites of the South and Central Belt (FIG. 7.33).

Extremes are also reported for the representation of infant burials (FIG. 7.34). In the South, early to mid-Roman and mid- to late Roman phases and villa sites were reported with high numbers of infant burials. This could on the face of it suggest that a high infant mortality risk only occurred

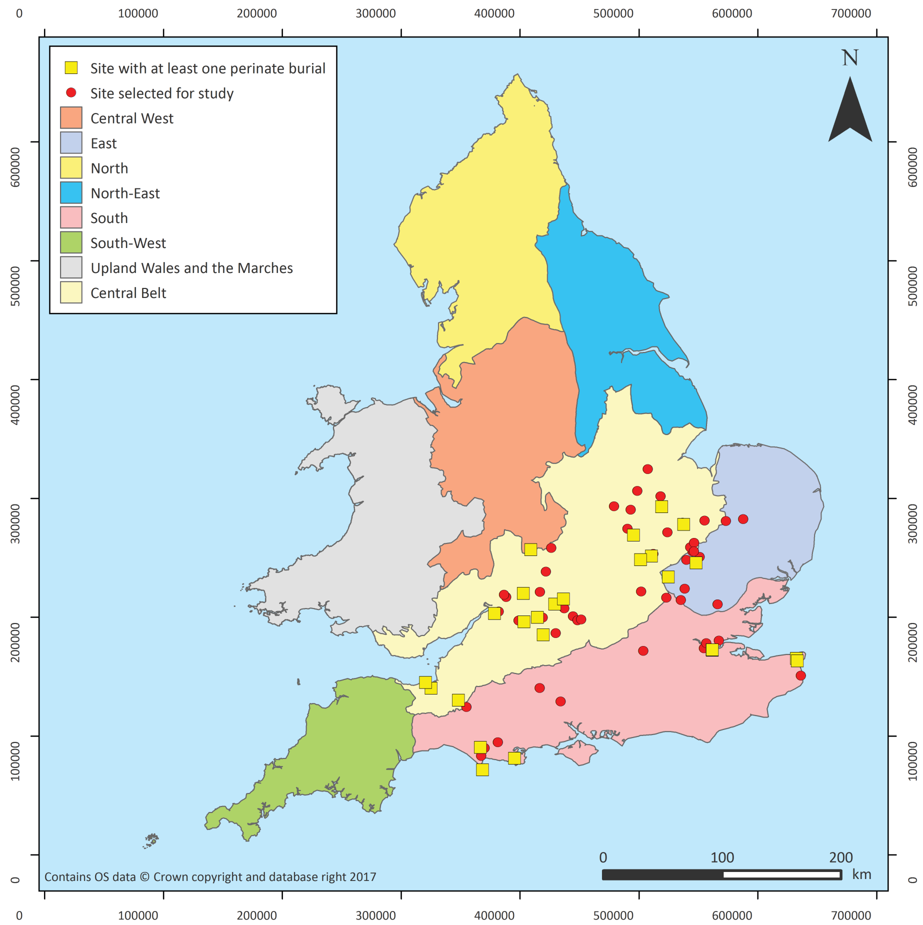

FIG. 7.33. Distribution of sites with at least one perinate burial reported

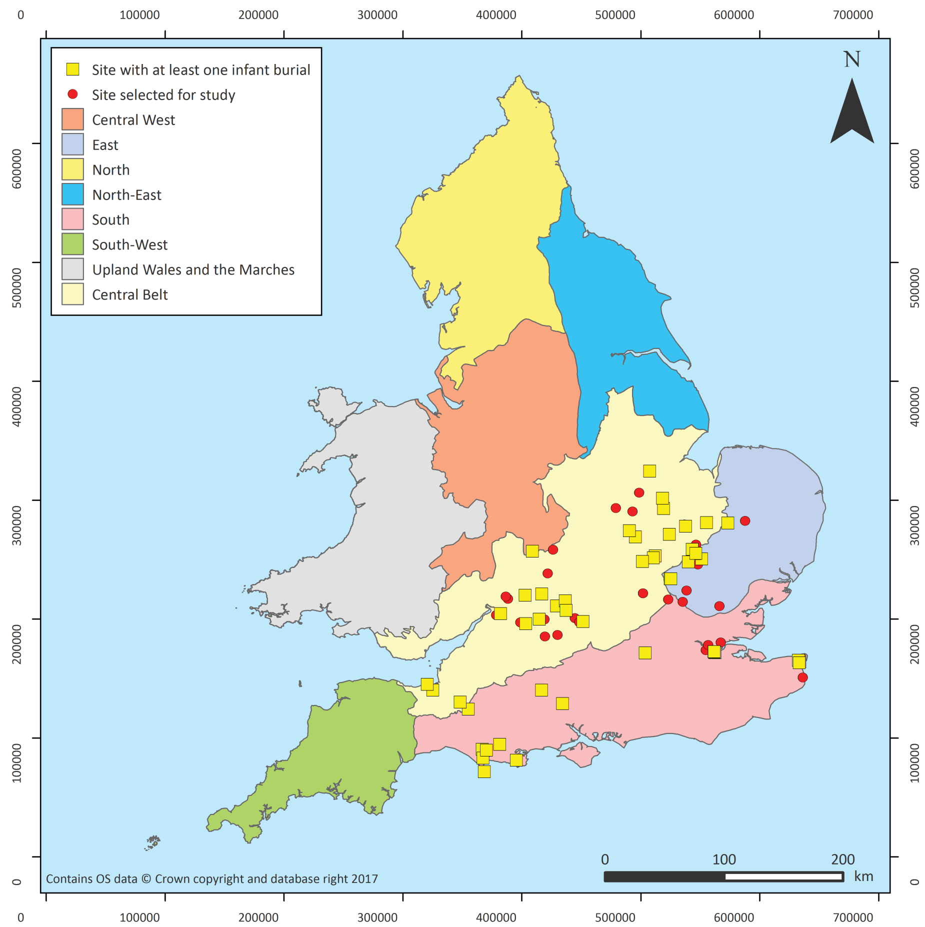

FIG. 7.34. Distribution of sites with at least one infant burial reported

during specific phases and at one particular settlement type. The defended small town at Alcester, Warwickshire, was also characterised by high infant mortality, which could suggest that infections, accidents or nutritional problems were having a significant impact on infant wellbeing at this site. In contrast, low numbers of infant burials at funerary sites and during early and late Roman phases are apparent across all three regions. This could mean that environmental risk factors for infant survival were low, but only in sites of early or late Roman date, and in those unknown satellite settlements served by a dedicated cemetery site.

Such extreme fluctuations in the proportions of perinate and infant burials, and therefore biological and environmental factors, seem unlikely in a pre-industrial rural society (Vögele 1994; Lewis and Gowland 2007; Humphrey *et al.* 2012). Perhaps it is not differential mortality risk at birth and during infancy that we observe, but rather differences in the burial and recovery of those dying very young. Several earlier studies discuss the inherent problems faced when interpreting demographic profiles of Romano-British sites, with high proportions of perinates and infants on one side, and their complete absence on the other (see Philpott 1991, 101; Scott 1991, 120; Esmonde Cleary 2000; Pearce 2001; 2013; Wileman 2005, 80–1, 99; Moore 2009; Gowland *et al.* 2014; Millett and Gowland 2015; see also Ch. 6, p. 231).

In his *Naturalis Historia* VII [15], Pliny describes children as lacking a soul until teething at around six months old. Perhaps this crucial point in the lifecourse of children marked those who did not attain it as separate, i.e. without a soul. Those who died prior to teething may, therefore, have been treated differently in death and excluded from formal cemeteries (Philpott 1991, 101). Regarding the low numbers of infants reported from funerary sites, it has been suggested that a set of distinct infant burial rites may have been practised in rural Roman Britain. If the objective was to protect the child in the afterlife, particularly if he or she was without a soul, a burial location that allows the infant to remain with the living may have been favoured (Millett and Gowland 2015). Additionally, beliefs about fruitfulness and fecundity of the women and the land may have come into play, perhaps placing infants in the domestic or agricultural sphere rather than formal burial grounds (Finlay 2000; Tibbetts 2008; Chadwick 2012). Regardless of motivation, this may lead to areas of a site or cemetery with a high density of perinate or infant burials. Examples of these are apparent across the regions. The villa at Frocester Court in Gloucestershire is characterised by high numbers of perinates (n=35) who make up 85.4 per cent of the non-adult population (n=41). This is even more intriguing since no infants were reported at the site. Perinates were often interred in oval graves, scattered throughout the site at Frocester Court, in association with ditches and building structures of Roman date (Reece 2000, 204–5). At Baldock roadside settlement in Hertfordshire, 24 (70.6 per cent) of the 34 reported non-adult burials were those of perinates. As discussed in Chapter 6, this roadside settlement is characterised by a large number of cemeteries around its periphery, as well as burials reported from within the settlement itself (Stead and Rigby 1986, 81; Burleigh and Fitzpatrick-Matthews 2010, 31). At Camp Ground, Colne Fen, the inland port in Cambridgeshire, perinates accounted for 83.3 per cent (n=10) of the non-adult sample (n=12). It is likely that the site had a formal burial ground, lying either to the south or west, which remains to be discovered, and this would indicate that the perinates were those newborns excluded from the formal cemetery. Interestingly, these perinates were also distributed throughout the site, associated with postholes, enclosures and ditches (Evans 2013a, 230). The villas at Bucknowle in Dorset and at Itter Crescent, Peterborough, in Cambridgeshire, have high numbers of post-neonatal and infant burials, accounting for 88.1 per cent (n=59, n=67) and 95.5 per cent (n=21, n=22) of the total non-adult burials. Burial was observed within buildings at Bucknowle villa (Robb and Rogers 2009), while infants were recovered from pits and ditches, as foundation deposits, and in association with the tile kiln and stone villa building at Itter Crescent (Webb forthcoming). The roadside settlement at Staines, Surrey, saw sixteen burials of infants aged seven months and younger, who formed the majority of human burials reported from the site (Chapman 2010).

With the spread of Christianity during the later Roman period, we may expect inclusion of infants in formal cemeteries, alongside adults and older children (Petts 2004; see Ch. 6, p. 279). However, at the third to fifth century A.D. urban cemetery at Poundbury Camp, Dorchester, Dorset, Molleson (1989) suggested baptism as a rite of passage that dictated inclusion of infants in the formal cemetery. Burying unbaptised children away from baptised members of the community is a long-standing Christian tradition (Finlay 2000), though distinguishing such unbaptised children of Christian communities from other 'pagan' infant burials found integrated within settlement contexts is of course impossible. As discussed in Chapter 5, there is also great uncertainty as to the actual impact of Christianity on the rural population, as we cannot measure how widespread this new belief system actually was across rural communities of the province.

The highly variable proportions of infants and perinates in the burial grounds of rural Roman Britain may be a confirmation of one of the major limitations of the study. Perhaps the youngest members of society were awarded archaeologically invisible funerary rites, which varied through both time and space. This may have caused their under-representation or absence at times, particularly within cemeteries. Dedicated 'infant corners' may have been created within some of the larger, formal burial grounds, although so far evidence for this is lacking (Philpott 1991; Esmonde Cleary 2000; Moore 2009; Pearce 2013). High numbers of perinates and infants at certain sites would seem to be a reflection of dedicated burial space within the settlement itself, or in association with boundary features, such as at Barton Court Farm in Oxfordshire (see Ch. 6, p. 248). If these kinds of burial locations were favoured, then we are going to observe high numbers of infants or perinates for a site where no formal cemetery has been excavated. These burials are not hasty and haphazard disposals of unwanted babies, but mark a community's effort to maintain a close bond between the living and those who have died very young (Carroll 2011).

Ultimately, the underlying reasons behind differential burial rites for babies have still to be fully explored. The withholding of perinates and infants from the rest of the dead community may have had many underlying motivations and were probably not the result of a single belief or cultural identity.

Palaeopathology of the buried population: prone burial, decapitation and grave goods

As discussed in Chapter 6 (p. 226), decapitated and prone burials are of great interest to archaeologists and the public alike. Equally, elaborate inhumation burials with an array of grave goods seem to warrant greater attention, as we often perceive these individuals to have been outstanding in both life and death. A way of investigating if the men, women and children buried in these unusual graves were 'different' is by evaluating their biological data in comparison to those buried in 'standardised' inhumation graves (Parker Pearson 2003; Pearce 2008).

At Kempston, Bedford, Boylston *et al.* (2000) observed that neither sex was favoured for prone burial or decapitation, a trend also apparent across the regions. The lack of patterning we have observed in prone and decapitation burials regarding sex distributions acts as a reminder that these particular rites may not have had a gendered origin in rural societies. Decapitated and prone burial were primarily reserved for adults, and frequently associated with old age. A higher likelihood of prone burial in older individuals was also noted at Kempston, although decapitation affected individuals of all ages (*ibid.*). It is likely that both prone and decapitated burials were a minor part of the normative funerary practice of particular communities, possibly negotiated by cultural, regional, social and biological factors (Strück 2000; Milella *et al.* 2015; Crerar 2016; see Ch. 6, p. 279).

Overall, those of older age were more frequently accompanied by grave goods. This is interesting as the opposite has been noted at the fourth to fifth century A.D. cemetery at Butt Road, Colchester, and in the 1967–1972 excavations of the fourth-century A.D. cemetery at Lankhills, Winchester (Clarke 1979; Crummy *et al.* 1993; Gowland 2007). Perhaps a range of attributes, like marriage or parenthood, had to be acquired through the lifecourse, and older age therefore correlated with a more secure or higher social status that warranted the offering of grave goods in older individuals in rural communities (Harlow and Laurence 2007). Although grave goods were statistically more frequent in the adults of the Central Belt and South regions, burials of children as young as infants were furnished across all areas. In the children of the South and East regions, the highest frequency of grave goods was apparent in those that would have been weaned, i.e. 2.6–6.5 years old (Fuller *et al.* 2006; Nehlich *et al.* 2011; Redfern *et al.* 2012; Powell *et al.* 2014). The distribution of grave goods among the children of the Central Belt differed, and 6.6–10.5 year olds stand out. It was suggested by Rohnbogner and Lewis (2016a) that children may have commenced their working lives within this age group. If this was indeed the case, death in association with this important milestone in the Romano-British lifecourse may have incurred the need for grave goods (Redfern and Gowland 2012).

When discussing palaeopathology in furnished, prone or decapitated burials, we have to consider small sample sizes. Unusual burials may also generate greater interest from excavators and specialists, which may result in a more detailed skeletal analysis and subsequent bias with palaeopathological data. A prone body position has been reported in child burials where the palaeopathology suggests a disability (Southwell-Wright 2014). Examples include a congenitally deaf 6-year-old from Poundbury Camp, Dorchester, buried prone in a cist constructed of limestone roof tiles (Farwell and Molleson 1993, 29, 188). At Lankhills, Winchester, a 4–7 year old with scaphocephaly, a form of premature cranial suture fusion, was placed in the grave prone. The child, believed to be a girl based on the grave goods, was wearing bracelets and finger-rings

(Clough and Boyle 2010, 372). A range of congenital conditions do not translate into the skeletal record, although they would have had an impact on social and cultural relationships while alive, perhaps marking certain individuals as different or 'other' (Foucault 1988).

In the Central Belt, significantly higher rates of enamel hypoplasia, trauma and caries were observed in the decapitated adults, attesting to early childhood stress through fever or infection, hazardous activity and poor oral health exacerbated by weakened enamel and the caries-promoting function of stress (Hong *et al.* 2009). Perhaps this may indicate an overall lower status and somewhat more physical lifestyle for these individuals. In the South, instances of enamel hypoplasia were significantly lower in adults buried with grave goods, suggesting differences in the early childhood experience between those afforded grave goods, and those without. Grave goods are often used as an indicator of higher status, and less exposure to early childhood stress in those given grave goods supports this hypothesis.

Burial rites and palaeopathology: summary

We are still speculating about the social, cultural or religious reasons that initiated changes in the burial rites or location of resting places of infants and newborns. The study has demonstrated that the issue is no longer one of urban–rural difference as previously suggested by Rohnbogner and Lewis (2016a). It is apparent that differences in burial practice existed within rural communities themselves, and future work must explore these further to try and understand the underlying motivations. The issue is complex, however, as recording and reporting of infant burials is fraught with inconsistencies regarding the ageing of perinate and infant skeletons. Often, these little bones will end up on the spoil heap, are only recognised during sieving, or are wrongly identified as those of animals during excavation. Context for these important burials is therefore lost, and contributes little to our efforts in reconstructing the beliefs and behaviours associated with the decision to bury an infant or perinate differently from older children or adults.

Regarding prone and decapitated burial, and the gifting of grave goods, observed trends in sex distributions and age-at-death confirm that 'deviant' or high-status rites were probably not reserved for a particular group. However, we do see a limited relationship between ill-health in life and the funerary rite awarded, albeit one that is regionally confined. Exposure to early childhood stressors was lower in those afforded grave goods in the South, and we would associate higher status with better health. However, we would expect to see similar results across the regions, and not only southern sites. In contrast, the palaeopathology of the decapitated adults of the Central Belt suggests a physically active group with poor dental health and episodes of ill-health in childhood. Overall, these factors may be indicative of a lower status group, although we have to question why these patterns are only apparent in Central Belt sites. The regional variation in relationships between burial rites and health highlight the fluidity of these practices.

THE CHILDREN – GROWING UP IN THE EAST, SOUTH AND CENTRAL BELT

The skeletal remains of children (i.e. non-adults ages 0–17 years) provide a unique window into observing environmental pressures on past populations. However, the nature of the data available, with a large amount of missing information, and crude prevalence rates as our sole means of discussing palaeopathology in the non-adults, makes this a difficult pursuit. The methods used for recording non-adult palaeopathology differed widely, resulting in unintentional under-representation and omission of lesions in the children. A greater range and higher frequency of non-adult palaeopathology is apparent in the Central Belt. This has to be treated cautiously, as the large non-adult cohort of the Cannington cemetery, Somerset, was re-analysed by the author and therefore yielded a detailed record of palaeopathology. However, this is an important new dataset and the biggest of its kind, allowing general observations on childhood health and lifeways beyond the urban centres of Roman Britain for the first time.

Infancy and the weaning period

Transitional feeding becomes necessary at six months old, as breast milk alone no longer meets the nutritional requirements of the growing child (Sellen 2007; Katzenberg 2012). The weaning period itself is a perilous stage in childhood development, characterised by malnutrition–infection interactions that impact on wellbeing and ultimately survival of the child (McDade and Worthman 1998; Fewtrell *et al.* 2007). A number of regional isotopic studies for Roman London (Powell *et al.* 2014), Queenford Farm, Oxfordshire (Fuller *et al.* 2006; Nehlich *et al.* 2011), and several sites across Dorset (Redfern *et al.* 2012) suggest that weaning was completed between 2 and 4 years old. At this point, it is also worth considering the results from fourth to second century B.C. Wetwang Slack in the East Riding of Yorkshire, where isotope analysis suggested that weaning would have been complete by 2.5 years old.

The introduction of supplementary foods would have also occurred very early in infancy at the site (Jay *et al.* 2008). A very specific onset for supplementation is given for Roman London, where solid foods were first introduced at six months old (Powell *et al.* 2014). This is in accordance with the second-century A.D. Greek physician Soranus' recommended weaning timeframe (Temkin 1991, 117). Some of the expected shortcomings of the weaning process are reflected in the palaeopathology and the representation of ages-at-death in the rural non-adult cohort. We see a slight increase in mortality rates after infancy at 2.6–6.5 years old, indicating raised mortality towards the end of the weaning period. Additionally, by 1.1–2.5 years old, supplementary feeding would have been well underway, and an increase in haematopoietic lesions, inflammation, infection and metabolic disease was observed. In combination, these suggest elevated morbidity during the weaning process, requiring a consideration of the different factors that may have contributed to this.

Lesions not only indicate maladaptive infant feeding practices, but also compromise health in breastfeeding women. Mothers may not have been well enough to produce breast milk, forcing the administration of other, less holistic and ultimately more harmful foods. The milk of cow, sheep or goat cannot be tolerated well by the developing infant gut flora, leading to diarrhoeal disease, malnutrition and infection (Fewtrell *et al.* 2007; Stevens *et al*. 2009). However, if the cultural norm was to introduce supplementary foods earlier than six months, we would expect to see similar consequences for the child. In fact, the isotopic study of non-adults younger than six years old from Iron Age Wetwang Slack attests to very early supplementation with animal milk and plant foods (Jay *et al.* 2008). Especially in young infants, early reliance on cereal-based foods would have interfered with the intestinal absorption of iron through high intake of phytates (Facchini *et al.* 2004; Nielsen *et al.* 2013). The result would have been chronic iron-deficiency anaemia, apparent as cribra orbitalia and porotic hyperostosis in those of weaning age. Retention of Iron Age practices in the rural population may therefore also have had a negative impact on health and wellbeing of weanlings. A greater body of work on the palaeopathology of Iron Age non-adults, particularly those of weaning age would help us to better integrate these observations. Earlier weaning in a rural context would make sense as it would have allowed mothers to return to work.

On the other hand, some of the mothers may have followed Soranus' advice of starving the newborn, feeding the infant with goats' milk and honey, or avoiding colostrum, a form of milk produced in late pregnancy and the few days after giving birth (Temkin 1991, 88–90). Withholding colostrum may have an effect on passive immunity of the newborn, as this early type of breast milk is particularly nutrient-dense and rich in antibodies. It helps to protect the newborn against bacteria and viruses, and lowers the risk for jaundice (Swishers and Lauwers 2011, 188–9). Honey, whether raw or boiled, may cause infant botulism, resulting in muscle paralysis and, in extreme cases, respiratory arrest (Aureli *et al.* 2002; Nevas *et al.* 2002). Perhaps maternal wellbeing was under greater threat in areas of the South and Central Belt. During pregnancy, severe malnourishment and extreme depletion of vitamin D status can cause the transfer of scurvy and vitamin D deficiency from mother to child (Wagner and Greer 2008; Robbins Schug and Blevins 2016). Equally, micronutrient content in breast milk, particularly of iron and vitamins B6/B12, is subject to maternal diet (Kumar *et al.* 2008; Allen 2012). Both iron and vitamin B6/12 deficiency in the mothers may have contributed to the haematopoietic lesions observed in young children of farmstead and roadside settlements of the Central Belt and perhaps at Chignal St James villa in the East.

Soranus' recommended weaning diet based on cereal foods was isotopically validated at Roman London (Powell *et al*. 2014), and may be traced via dental disease in young children. Infection with *S. mutans*, the main caries-causing bacteria is highest at around two years old, and lesions will develop from 13–16 months after colonisation (Kawashita *et al.* 2011). The presence of caries in 2.6–6.5 year olds therefore suggests that cariogenic foods may have been given as part of the transitional diet. These would have been in the form of soft carbohydrate-rich foods, most likely porridge or bread soaked in milk, wine or honey (Temkin 1991, 117–19; Garnsey 1999; Freeman and Stevens 2008).

No cases of metabolic disease were reported in the children from villas. Sampling bias may be partly responsible for the absence of reported cases, as 86.2 per cent (n=131) of the 152 non-adults from villa sites were perinates and infants. Diagnosing vitamin C or D deficiency in these young individuals is notoriously difficult. Porous new bone is deposited rapidly due to natural growth in this age group, and may mimic or mask pathological lesions (Ortner *et al.* 1999; 2001; Kwon *et al.* 2002; Rana *et al.* 2009). Rickets and scurvy were reported in the villages, farmsteads and roadside settlements of the South and Central Belt. Apart from diet, these conditions also inform on early childhood rearing practices and socio-cultural factors. Rickets has been linked to low socioeconomic status that prompts inadequate nutrition, i.e. calcium deficiency and too little time spent outdoors (Urnaa *et al.* 2006; van Sleuwen *et al.* 2007). Scurvy should be absent in a rural environment, which may suggest more general mal- or under-nutrition in these young children, perhaps due to preferential feeding and resource allocation within the household or community (Crandall and Klaus 2014; Stark 2014). Appropriate foods may not have been available at times, and young children, perhaps being generally poorly, may have been kept indoors or carried in a sling for prolonged periods, leading to both rickets and scurvy on these rural sites.

Later childhood and adolescence

Few older children and adolescents were reported across all regions. This result was expected as mortality should tail off after the perilous periods of birth, infancy and the weaning period (Lewis 2010). Haematopoietic and non-specific stress, observed as cribra orbitalia, porotic hyperostosis and enamel hypoplasia were seen across all regions, and most ages and settlement types. An overview of enamel hypoplasia in children from contemporary major urban sites yielded a CPR of 17.8 per cent (Rohnbogner 2015), which is significantly higher than the rates of 5.6 per cent reported in the East, 4.8 per cent in the South, and 7.5 per cent in the Central Belt (X^2=33.99, p<0.001, d.f.=3). Early childhood stress may have been less severe on rural sites. Equally, this may be a weaker cohort, where children succumbed to stress before lesions were able to form (Goodman *et al.* 1988; Wood *et al.* 1992).

Cribra orbitalia and porotic hyperostosis affected 1.3 per cent (n=1) of children in the East, 2.3 per cent (n=8) in the South, and 10.0 per cent (n=51) in the Central Belt, which is significant (X^2=25.63, p<0.001, d.f.=2). We have to acknowledge the possibility of sampling bias for this result as the large Cannington funerary site was re-examined by the author during PhD research. Yet the distribution may be an indicator for regional variation in childhood health in rural Roman Britain. Collectively the children of the Central Belt may have been under greater haematopoietic stress as demonstrated by cribra orbitalia and porotic hyperostosis at complex and unclassified farmsteads, funerary sites, roadside settlements, villas and the defended small town at Alcester. This could have been brought about by a variety of factors, including parasitic infection, diarrhoeal disease, and mal- or under-nutrition (Walker *et al.* 2009; Oxenham and Cavill 2010). We see further evidence for dietary shortcomings in older ages at 6.6–10.5, and 10.6–14.5 years, where scurvy was reported in the roadside settlement at Bourton-on-the-Water, Gloucestershire, and the funerary site at Cannington, Somerset. The withholding of foods and resources and more widespread mal- or under-nutrition have to be considered here (Crandall and Klaus 2014; Halcrow *et al.* 2014), as access to foods rich in vitamin C should be plentiful in a rural setting. In a market economy, this relationship may be reversed, and result in shortages or lower quality produce available to the farming population, and hitting those reliant on the care of others the hardest (Stark 2014).

In the East and South, mortality rates are raised slightly in adolescents and 10.6–14.5 year olds. From the age of 6.6–10.5 years onwards, we see a general decline in health. This may have been due to a change in lifestyle, as for example the start of working life, resulting in greater exposure to pathogens, environmental, dietary and occupational stress. Cases of respiratory disease were reported in 6.6–10.5 and 14.6–17.0 year olds, highlighting that a prolonged amount of time was spent in smoke- and particle-polluted air (Roberts and Manchester 2010, 18). Children may have done so to either rest from illness, or to fulfil chores. Fractures attest to falls and accidents that may have been sustained either during play or work. Further evidence for strenuous activity comes from a 16-year-old female at Cannington, Somerset, who was reported with Schmorl's nodes (Brothwell *et al.* 2000, 203), pointing to prolonged strain on the back (Plomp *et al.* 2012).

A build-up of dental plaque (calculus) and caries serve as indicators of oral health and diet (Halcrow *et al.* 2013), with both conditions reported across all regions, and more frequent in older age groups. We would expect to see this pattern due to the age-progressive nature of dental disease and calcified plaque (Larsen 1997; White 1997). Overall, in comparison with children from major urban sites with a reported CPR of 14.8 per cent (Rohnbogner and Lewis 2016b), caries frequencies are lower in the East (6.3 per cent), South (6.7 per cent) and Central Belt (6.0 per cent), although the result is not significant (X^2=11.16, d.f.=3). It is likely that rural children ate a different diet than children in urban settlements. Fibrous and tough foods, and low and infrequent intake of sweetened, soft and refined foods, would have resulted in lower caries frequencies (Powell 1985; Duray 1992; Moynihan 2000). Access to foods was linked with social status (King 1984; 1999a; 2001; Cummings 2009), and the dental health of the rural children, coupled with evidence for vitamin C deficiency, may be a reminder of lower social standing of the rural population (Klaus 2012). In the Central

Belt, calculus was reported at significantly higher rates in children from complex and unclassified farmsteads. This may suggest dietary variation within the settlement types of the region, as calculus deposits are more likely to form when a high-protein or high-carbohydrate diet is consumed (Roberts and Manchester 2010, 71). Only in the Central Belt do we see dental disease in children of the villa sites, affecting two individuals (12.5 per cent) in this settlement type. These are very small sample sizes, and we have to be careful not to over-interpret this result as evidence for the consumption of higher status foods by these children. Similar to the limitations with metabolic disease, the result is influenced by the availability of only 21 non-adults from villas with a reported age over one year old for dental eruption.

The children: summary

Overall, children of the countryside exhibited low rates of pathology, and experienced similar stresses across the regions. Dietary deficiencies may be indicative of shortcomings in access to resources, maternal health and infant feeding and weaning practices. A point to remember is that infant feeding and the weaning process are highly variable, depending on the individual and unique characteristics of both mother and child. However, we do see an increase in morbidity in the weaning age group of 1.1–2.5 years old, and an increase in mortality at 2.6–6.5 years old, which would correspond with the suggested timeframe for the complete cessation of breastfeeding. Rural Romano-British weanlings may have been fed on inappropriate supplementary foods, the mothers themselves may have been poorly resulting in breast milk low in nutrients, or inadequate weaning strategies were in place such as supplementing too early, or prolonged feeding with breast milk past the age of six months old. Without the insight of isotopic analysis on a large sample of weanlings and their mothers, it is difficult, perhaps even impossible, to tease apart the specific underlying causes of lesions in those of weaning age. What is interesting is that we cannot rule out either Roman or native Iron Age practices for weaning in a rural environment. Perhaps an amalgamation of recommended Roman and local long-established behaviours were adopted towards weaning and early child rearing.

Older children were equally sensitive to dietary and environmental pressures. Compared to urban children, those growing up in a rural environment may have experienced fewer episodes of early childhood stress in the form of fever or infection. Some of the skeletal evidence suggests that children may have experienced a shift in lifestyle from 6.6–10.5 years old, possibly an indication of commencing work or being tasked with carrying out chores. Particularly in the Central Belt, resource stress in the form of food shortages or lower quality foods may have affected the children. Additionally, dental disease rates attest to a simpler diet eaten by the children in the countryside compared to their urban peers. These observations may be taken as a reminder of lower social standing of the rural population under Roman administration.

THE ADULT POPULATION OF THE EAST, SOUTH AND CENTRAL BELT

Demography: age-at-death and sex

The information we can glean from mortality rates and sex distributions of the rural population is limited by our ability to provide accurate and precise age estimates in adult skeletons (Chamberlain 2000). Villa sites stand out in the East and Central Belt for providing us with conflicting mortality patterns. In the East, the only records from a villa site saw high mortality in the middle adult age group, although significantly fewer middle adults were observed on villas in the Central Belt. Several formal burial locations were identified at Chignal St James Roman villa in Essex, which may have had an impact on the demographic data available to us (Clarke 1998). Equally, we only have a limited sample available for villas in the Central Belt. At Watersmeet in Cambridgeshire, burials were found in the cemetery area and outlying ditches (Nicholson 2006b), whereas no formal cemetery area was identified at Frocester Court, Gloucestershire, with infant remains scattered throughout the site (Price 2000). At Itter Crescent, Peterborough, in Cambridgeshire, intra-mural burial of non-adults was observed, alongside adult inhumation burials spread across the site, some of which were disturbed or disarticulated (Pickstone 2011). Mortality patterns on villa sites should therefore be approached with caution, as bias in burial and excavation would have influenced the results. Despite these limitations, the significantly higher mortality rate of middle adults at Chignal St James villa compared to other settlement types of the East, and to villas in the Central Belt, is interesting. Perhaps the buried population at Chignal St James experienced a particularly strenuous lifestyle. To an extent, this is also reflected in the adult palaeopathology at the site, and has led Clarke (1998, 140–1) to suggest that the skeletal population may have been bonded tenants (*coloni*) of the villa estate. This is certainly an interesting interpretation, and ideally should be contextualised using data from villas throughout the province. However, in the absence of meaningful sample sizes for this settlement type, we currently cannot comment any further.

In young adults, the number of women within the buried population outnumbered men in all regions. This may be a result of female depletion over time due to multiple cycles of pregnancy and lactation, and the risks associated with childbirth (Chamberlain 2006). Pre- and post-partum hazards such as toxaemia or haemorrhage do not affect the skeleton, therefore preventing us from testing this hypothesis on the skeletons of these young women (Slaus 2000). We also have to consider migration here, as young men may have migrated from rural settlements for economic reasons (see Eckardt 2010a; McCarthy 2013). However, it is worth stating here that the skeletons of young adult males may in fact look rather gracile and lean towards feminine traits for sex determination, which may have influenced the sex ratios in this age group (Walker 1995; 2005).

Old age was more frequently attained by men in the South and Central Belt, as opposed to women in the East. Before we discuss underlying factors of the demographic differences, we have to consider some site-specific caveats. Only a few women were reported from the village site at RAF Lakenheath, Caudle Head Mere in the East, the Springhead Sanctuary complex in the South, and the industry/villa site at Priors Hall, Weldon, in the Central Belt. Perhaps unsurprisingly, more men would have lived and died at the late Iron Age/early Roman ironworking site of Priors Hall, Weldon (Hall 2006). However, the inhumation graves at the site are badly preserved. The latter may have caused discrepant sex ratios, rather than being a true representation of demography of the living population at the site. The sex distribution at Springhead Sanctuary complex also has to be approached with caution owing to the nature of the site and frequent redeposition of burials (Barnett *et al.* 2011; McKinley 2011). Reports on the excavations at the village site at RAF Lakenheath in the East remark on disturbance of the areas under investigation, and dispersed locations of the burials recovered (Tester 1993). Together, these factors would have affected the demographic profile of the reported burials at the site. Similar to the issues of sexing young adult males, more robust and masculine features may be apparent in old adult females, perhaps raising the proportionate representation of old adult males across the sites and therefore regions (Effros 2000; Walker 2005). With these caveats in mind, more women in old adulthood in the East may be a result of the physically more demanding lives men may have led. In turn, the sex distribution in the South and Central Belt may signify that women were leading equally strenuous lives, causing fewer of them to live into old age. We can only say that these men and women were older than 46 years on average, rather than commenting on all of them being elderly. Frailty, illness and disability may have affected all these individuals differently, as would have the level and quality of care they received.

Childhood stress and survivorship

Cribra orbitalia affected both sexes at similar rates in the East and Central Belt, although the highest percentage of affected individuals was in the South (9.3 per cent). Within this region, the greatest discrepancy between men (11.3 per cent) and women (17.9 per cent) was observed. Similar trends are apparent in the distribution of enamel hypoplasia, which was significantly more frequent at Chignal St James villa (47.4 per cent) than elsewhere in the East. Notably, an old adult male from the only village site in the region was reported with hypoplasia of the third molar, which is formed between 10–12 years old (Moorrees *et al.* 1963). Chronic biocultural stress in childhood affected the inhabitants at Chignal St James villa to a greater extent than elsewhere in the East (Salvadei *et al.* 2001; Steckel 2005). Indeed, Clarke (1998, 140–1) described exploitative conditions at the site, based on the palaeopathology of the inhabitants (see above, p. 333). The ironworking site at Priors Hall, Weldon, was characterised by significantly higher rates of individuals with enamel defects. Elevated stress in childhood is not unexpected, considering the metallurgy and industrial exploitation at the site, which was followed or even coincided with a villa estate at nearby Weldon (Hall 2006).

In comparison to the children, significantly more adults were reported with enamel hypoplasia and cribra orbitalia in the South, and we see proportionately more adults with enamel lesions in the Central Belt. This does conform with the 'Barker hypothesis' that ascribes an early childhood origin to illnesses in later life, which may have had an impact on mortality risk (Armelagos *et al.* 2009; Gowland 2015). Watts (2015) stated that enamel hypoplasia reflects early childhood short-term periods of stress that may not be disruptive enough to cause long-term damage to health, which may have been the case for these adult individuals. The men and women of the South and Central Belt may reflect the overall stronger cohort, as despite experiencing chronic biocultural stress during childhood, these individuals were able to flourish and attain adulthood (Paine and Boldsen 2002). The higher rate of cribrotic lesions in the adult cohort of the South compared to the children may have arisen due to similar reasons, or alternatively migration to the area. Another theory that may be considered is the presence of malaria in southern England, particularly the marshlands around Kent and Essex where it became known as 'marsh fever' (Dobson 1980; Mendis *et al.* 2001; Sallares 2002). High prevalence of malaria within a population is selective towards individuals with acquired or genetic anaemias that enable resistance (Ayi *et al.* 2004; Harinarayan *et al.* 2007), resulting in high rates of cribra orbitalia and porotic hyperostosis (Soren 2003; Gowland and Garnsey 2010). Periosteal new bone formation is also prevalent in populations where malaria is endemic (Smith-Guzmán 2015), and was reported at 11.3 per cent of burials in the South, compared to 5.0 per cent in the East and 6.1 per cent in the Central Belt. Although cribra orbitalia was more frequent in southern adults than in any other region, porotic hyperostosis only affected 1.0 per cent. In contrast, over twice the rate was reported in the East (2.1 per cent). Demographic data, and palaeopathological studies of Roman, Anglo-Saxon and late medieval cemeteries around the fens and marshlands of Cambridgeshire and Lincolnshire, demonstrated acquired immunity to endemic malaria in local populations (Kuhn *et al.* 2003; Kendall 2014). Therefore, we should also be seeing significant rates of cribra orbitalia in the children, and particularly adults of the East. This was only observed at Chignal St James Roman villa, where porotic hyperostosis was reported in 21.2 per cent of adults, and cribra orbitalia affected 20.0 per cent of children and 15.8 per cent of adults. It would be unlikely for malaria to affect the inhabitants of a single site only, especially as Chignal St James villa is situated away from the coastal marshes. The generally low rates of cribrotic lesions in the East may therefore indicate the absence of endemic malaria in the selected study sites of the region. We also have to bear in mind the limitations that would have influenced these observations. Crude prevalence rates are heavily influenced by preservation on each study site, which is a major limitation. Inherent discrepancy in recording and reporting of non-adult versus adult skeletal remains would have also resulted in the under-representation of palaeopathology in the children.

Living environment: infection and respiratory disease

Bone infections (i.e. osteitis, osteomyelitis and endocranial lesions) were rare across the regions, perhaps pointing to a low risk for contracting infections, parasites and other diseases (Nelson 1990; Goodman and Martin 2002; Roberts and Manchester 2010, 168). New bone formation is a skeletal response to trauma, joint disease, circulatory disorders, skeletal dysplasia, haematological, neoplastic, metabolic or infectious disease. In the Central Belt, higher rates of new bone formation in the men may be a result of the various stressors and disease causing periosteal reactions, perhaps alongside a greater risk of soft-tissue injuries sustained at work (Weston 2008). The larger populations of nucleated roadside settlements may have prompted increased stress for their inhabitants and harboured a potentially more unsanitary living environment (Roberts 2000).

Leprosy was a disease well known during Roman times and described by Greco-Roman medical writers such as Celsus in the second century A.D. (Dirckx 1983). Lepromatous and tuberculoid leprosy were reported in four adults out of a total of 2717 individuals. The dating of the burials is of interest here. The old adult male with tuberculoid leprosy is from West Thurrock, Essex, a funerary site in the South of early Roman date, whereas the remainder are from the late and post-Roman cemetery at Cannington, Somerset, in the Central Belt. So far, only two additional cases of leprosy were reported, from Cirencester and Poundbury, dating to the fourth century A.D. (Reader 1974; Manchester and Roberts 1986; Roberts 2002). This would make the West Thurrock male the earliest find of leprosy in Roman Britain and he must have had close and frequent contact with others infected with *M. leprae* (Robbins Schug 2016). The individual was buried flexed on his left side in an unfurnished grave, cut into the top of a late Bronze Age/early Iron Age ditch. The dating of the burial stems from pottery and brooches in the cemetery, which revealed a first century B.C. to second half of the first century A.D. date for the burial ground (McKinley 2009, 28–30; Andrews 2009b). This could mean that the disease had an earlier origin in Roman Britain than previously thought, and was more widespread across rural settlements than we have so far anticipated. Since only a few cases are reported for Roman Britain generally, we have to consider that these individuals may have migrated with the disease and contracted it in crowded and unsanitary living quarters elsewhere (Roberts 2002). In fact, West Thurrock is situated relatively close to the River Thames and the entry into Roman London, which may make migration a likely route for the illness into the site.

Cases of tuberculosis in every region add further evidence for crowding and poor hygiene, particularly since tuberculosis requires re-infection of the latent primary infection to yield soft tissue, and in rare cases, bony lesions (Resnick 2002; Roberts and Buikstra 2003). Adult tuberculosis was reported in all sexes, ages and a range of settlement types, i.e. funerary sites, roadside settlements, farmsteads and villages, suggesting that close contact with livestock and ingestion of infected animal products contributed to the spread of the disease (Grange 2001; de la Rua-Domenech 2006). Significantly more adults from the South (2.8 per cent, n=11; X^2=15.62, p<0.001, d.f.=2) were reported with the disease compared to the Central Belt (0.4 per cent, n=5) and the East (0.8 per cent, n=2). Zooarchaeological evidence suggests that dairying of cattle took place around Winchester and Dorchester (Maltby 1994; 2010b), and it is possible that if cattle dairying was a more widespread part of the subsistence economy in the region, i.e. in rural settlements surrounding the towns, then perhaps bovine tuberculosis was more endemic in the South (Shitaye *et al.* 2007; cf. Allen 2017, 113–14). Subsequently, more frequent transmission from animal to human would have occurred. Human infection with the bovine strain is also more likely to produce skeletal lesions (Stead 2000), which allows us to identify the disease more readily. Again, early Roman West Thurrock in Essex is of interest here as two cases of possible tuberculosis were reported that could not be differentiated from brucellosis. The latter is a zoonotic infectious disease, spread by *Brucella* bacteria, contracted through the same mechanisms as bovine tuberculosis (Wilkinson 1993). In the south of England, *brucella* may have been present in animals since the Iron Age (Bendrey *et al.* 2008), possibly accounting for infection with brucellosis in the two cases. The dating of tuberculosis is also of interest, with all cases from the East dating to the late Iron Age and early Roman periods. A further five individuals of early Roman date come from the Central Belt (Milton, East Waste, Cambridgeshire) and South (West Thurrock, Essex, and Alington Avenue, Dorset). Although the earliest published skeletal find of tuberculosis is from Iron Age Tarrant Hinton in Dorset (Mays and Taylor 2003), these early Roman cases are important in confirming the antiquity of the disease in Britain.

Sinusitis and rib periostitis were present in every region, albeit at low rates. Maxillary sinusitis affected 0.4 per cent of adults in the East, 0.8 per cent in the South and 1.4 per cent in the Central Belt. Within the Central Belt, the roadside settlement at Higham Ferrers, Northamptonshire, and the villa at Itter Crescent, Peterborough in Cambridgeshire, saw significantly higher rates of sinusitis. Inhabitants at these sites may have been more frequently exposed to low-quality particle-polluted air and subsequent inflammation and infections. However, maxillary sinusitis may also arise secondary to a fistula or other periapical lesions affecting the maxillary dentition, which may have been the case for some of these individuals (Liebe-Harkort 2012). Other respiratory infections such as pneumonia or bronchitis would have led to new bone formation on the ribs (Roberts *et al.* 1994; Santos and Roberts 2001; Matos and Santos 2006). Lesions are, however, non-specific and were found in less than 1.0 per cent of individuals. Nevertheless, open hearths in crowded living quarters, or long hours spent working with industrial ovens or kilns, could have prompted respiratory infections on rural sites.

Diet: metabolic and dental disease

Nutritional deficiency diseases were almost absent in the adults. Yet, high rates of porotic hyperostosis were reported at Chignal St James villa in the East, tying in with additional skeletal evidence for dietary and environmental stress at the site, i.e. cribra orbitalia and enamel hypoplasia. Porotic hyperostosis in the adults at Chignal St James villa may have been a result of dietary deficiencies, an underlying genetic anaemia, or infection and inflammation (Ortner 2003, 89). Indeed, if we look to classical literary accounts describing life on villas in Italy and the Continent, descriptions of hard physical labour and unfavourable conditions prevail (Whittaker and Garnsey 1997, 284). However, if Chignal St James villa was representative of health on all villa sites, we would expect to see similarly high lesion frequencies in the villa sites of the South and Central Belt.

Although only a few cases of adult scurvy were reported, there is a trend for old adults and men to be affected, particularly around Somerset, Gloucestershire and the Isle of Thanet in Kent (East Kent Access). This mimics the distribution of vitamin C deficiency in the children, with non-adult scurvy prevalent at a funerary and village site along the East Kent Access Road, the roadside settlement at Bourton-on-the-Water in Gloucestershire and the Somerset sites of Bradley Hill (unclassified farmstead) and Cannington cemetery. Scurvy may develop in the elderly owing to the need for assisted feeding, poverty, poor access to adequate foods, reclusiveness and absent or poor dentition (Hirschmann and Raugi 1999). It is often termed 'bachelor' or 'widower' scurvy because of its frequent occurrence in elderly men (Richardson *et al.* 2002). Healed blunt force trauma to the left parietal was apparent in the old adult male with possible scurvy from the funerary site at Zone 19, East Kent Access (Dinwiddy 2015). He also suffered from a dental abscess, ante-mortem tooth loss and caries. Perhaps this individual struggled to recover from the consequences of the injury and was unable to chew foods properly, resulting in dietary deficiency.

Scurvy in adult skeletons is notoriously difficult to identify, so we have to be reminded that the disease may go unrecognised owing to poor preservation and the non-specific nature of new bone formation (Brickley *et al.* 2016). Vitamin D deficiency was reported in the South along the East Kent Access and at West Thurrock in Essex, and Bourton-on-the-Water roadside settlement and Cannington cemetery in the Central Belt, somewhat mirroring the distribution observed for the children. The metabolic disease was either reported as healed childhood rickets, or suspected osteomalacia with an onset in adulthood. The latter group were described as elderly, and perhaps were housebound and therefore experienced inadequate exposure to sunlight, whereas the former recovered from rickets in childhood (Gloth *et al.* 1995; Ortner 2003). A case of DISH was identified in one of the two elderly individuals from a funerary site along the East Kent Access (Zone 19). The only other example of this type of spinal ossification and ankylosis stems from an old adult male recovered from a farmstead at Zones 9 and 10 of the same project. These mark the only two affected individuals in the study sample (CPR 0.1 per cent for rural Roman Britain). In comparison, the crude prevalence of DISH at fourth-century A.D. Lankhills, Winchester, is 1.4 per cent (n=3 of 220). The aetiology of this type of spinal fusion and extra bone formation is interesting as it is linked with Type 2 diabetes and obesity (Rogers and Waldron 2001). Perhaps both of these old adult males were incomers to the area, or had access to a richer diet than the rest of the community.

Loss in bone density, described as osteoporosis, was reported in both males and females of old age, although only ten individuals from the South and Central Belt were affected overall. Osteoporosis often affects post-menopausal women, but is also seen in men as senile osteoporosis due to advancing age (Riggs *et al.* 1982). One of the elderly women presented with a femoral neck fracture, and another with wedging of lumbar vertebrae, both common fracture locations in patients with osteoporosis today (Center *et al.* 1999). The loss in bone density observed in the men and women may have been a result of hormonal changes, old age, immobilisation and subsequent vitamin D shortage through time spent indoors, and a diet insufficient in calcium or too high in protein (Roberts and Manchester 2010, 243).

There is clear evidence for regional dietary variation across Roman Britain, ranging from archaeobotanical and isotopic studies, to differences in butchery practices and material culture (King 1984; 1999a; 2001; Cool 2006; Van der Veen *et al.* 2007; 2008; Van der Veen 2008; Alcock 2010; Müldner 2013; also see Allen 2017 and Lodwick 2017c). Across the regions, caries and its associated lesions (i.e. tooth loss and periapical lesions/abscesses) were on the rise with increasing age, reflecting the age-progressive nature of dental disease (Larsen 1997, 65). Generally, the rate of dental disease was similar in men and women. Calculus was reported at comparable frequencies across the regions (South 33.6 per cent, Central Belt 29.8 per cent) although there is a trend for lower rates in the East (20.4 per cent). We actually see significantly lower numbers of adults with caries in the region at 16.6 per cent, compared to 36.0 per cent in the South and 32.5 per cent in the Central Belt (X^2=19.53, p<0.001, d.f.=2). A variety of factors contribute to the formation of caries, including fluoride content of food and drink, the prevalence of cariogenic bacteria, dental variants in shape and structure of teeth, diet, oral hygiene and genetic factors (Sreebny 1983; Powell 1985). Perhaps fewer food sugars were available in the diet of rural Roman Britons of the East, and soft and carbohydrate-rich foods were less frequently consumed. Natural fluoride content of ground water varies across England, and parts of East Anglia are characterised by raised fluoride concentrations, according to the Drinking Water Inspectorate (2013). Apart from diet, it may be equally likely that availability of calcium fluoride to individuals in the East lowered caries progression in childhood and therefore later in life.

Abscesses or pericapical lesions affected 8.9 per cent of adults in the East, 17.6 per cent in the South, and 10.5 per cent in the Central Belt. In fact, periapical lesions were statistically more frequent in the South than in the other regions (X^2=11.60, p<0.005, d.f.=2). This complements the findings on calculus and caries distributions for the South, as these dental pathologies will predispose a population to higher rates of dental abscesses and cysts. Perhaps, attrition, trauma and periodontal disease plagued people in the South more frequently than elsewhere and contributed to abscess formation (Roberts and Manchester 2010, 70). Some periapical lesions would have been benign, whereas some abscesses may have caused severe pain and secondary sinusitis (Melén *et al.* 1986). An important limitation of the data is the fact that periapical lesions and abscesses are only visible to the naked eye when they perforate the alveolar bone. If no systematic radiography was undertaken to assess dental disease (which it rarely is), a large proportion of lesions are missed.

Periodontal disease, caries and abscesses ultimately cause a tooth to die and be lost, evident as healing and remodelling of tooth sockets in archaeological bone (Roberts and Manchester 2010, 74). The discussion of ante-mortem tooth loss is problematic in this context. Tooth loss is recorded by total number of sockets observable, rather than by individuals as had to be done in this study. Ante-mortem tooth loss was highest in the South, which is in keeping with trends for dental disease in this region. However, more individuals in the East were reported with teeth lost ante-mortem than in the Central Belt. The relatively high rate of tooth loss in the East may have contributed to low rates of caries and calculus observed in this region owing to the absence of observable teeth.

In the Central Belt, statistically significant patterns between settlement types were apparent. It would seem that dietary variation existed within the region. High rates of caries in the industry/villa site at Priors Hall, Weldon, in Northamptonshire may be site-specific, and a result of discussing crude rather than true prevalence rates. High numbers of periapical lesions/abscesses in funerary sites, including Horcott Quarry, Gloucestershire, and Radley Barrow Hills, Oxfordshire, are complemented by high prevalence of caries and ante-mortem tooth loss. Within this cohort, dental health may have been generally poor. However, the larger funerary sites may have served a range of unknown satellite settlements (see Ch. 6, p. 249), and we cannot make inferences on the socio-cultural environment of these people. Nevertheless, it seems that those buried in such 'isolated' rural funerary sites had higher rates of dental disease than those who were not. Perhaps a richer diet, with greater sugar content and refined foods was eaten by certain parts of the population. The high rate of abscesses in the single port site of Camp Ground, Colne Fen, Cambridgeshire, is interesting as both caries and ante-mortem tooth loss were comparatively infrequent here. It may be likely that attrition and trauma influenced dental health at this site.

Working lives

Traumatic injuries and joint degeneration during life enable us to comment on activity levels in past populations. The crude prevalence for skeletal trauma is similar across the regions, and men exhibited trauma more frequently than women, significantly so in the Central Belt region. Activity patterns associated with the division of labour and risk-taking in men may have caused these distributions (Harris *et al.* 2006). Men may have been more often involved in high-risk activities as part of their working lives, for example in extraction industries, construction, ploughing or the clearing of woodland (McCarthy 2013). Women may have been in charge of the day-to-day running of the farm, tending to crops, animals and domestic chores (Allason-Jones 2005). Although these activities also carry risks of injury, perhaps, on the whole, women were less often exposed to accidents and injury, whether work-related or not. Spinal trauma is commonly sustained in falls and was most frequent in the East (Dryden *et al.* 2003), whereas rib fractures requiring significant blunt force to the thorax were most prevalent in the South and Central Belt (Sirmali *et al.* 2003). Both types of injuries can be sustained in accidents related to agricultural labour and working with traction animals. Tibial fractures, which were most frequently observed in the women of the East, require a considerable amount of force, often occurring in road traffic accidents and sports injuries today (Court-Brown and McBirnie 1995). Tibial fractures at Chignal St James were reported in two adult females, which may attest to the working environment to which these women were exposed. Rib fractures commonly affected women in the South and spinal compression fractures in the Central Belt. We see that women engaged in physical activity and associated hazards and were perhaps exposed to occupational risks. A higher rate of inter-personal violence was encountered by men in the East, resulting in high rates of cranial trauma alongside spinal injuries. Ante-mortem, and one case of sharp force peri-mortem, trauma to the temporal, parietal and frontal bones were reported in four adult males, which indicate a degree of inter-personal violence not witnessed in the women of the region (Alvrus 1999). A similar trend for gendered division of weapon trauma and inter-personal violence was observed in the South. The amputation of a right humerus at the mid-shaft in an old adult male at Alington Avenue in Dorset is a reminder that medical care was indeed available on rural sites. We also have to consider accidental amputation in this context, which attests to perhaps occupational hazards rather than treatment and care. However, well-aligned, healed long-bone fractures indicate that those with injuries were cared for, by immobilising joints and allowing broken bones to heal. Two additional cases of amputations of fingers were reported at Horcott Quarry, Gloucestershire. Amputations like these most commonly occur accidentally at work, frequently seen in circular saw injuries today and somewhat of an occupational hazard (Boyle *et al.* 2000). Weapon trauma not only affected men in the Central Belt, but also a woman with evidence for sharp force trauma to the ulna that resulted in infection. Trauma to the face was equally frequent among both sexes in the region. Yet, we do not know whether women experience facial and cranial trauma as a result of accidents, combat or abuse (Ochs *et al.* 1996).

In the East, joint stress primarily affected men, a pattern that was not apparent across the South or Central Belt, where females were equally likely to display lesions. Osteochondritis dissecans as a result of continued weightbearing and stress was limited to the feet in the East, whereas joints of the lower and upper limbs were affected elsewhere, particularly in the Central Belt (Hangody *et al.* 2001). The spondylolysis observed at farmsteads, villas, roadside settlements and villages across the regions attests to prolonged and repeated stress on the spine through lifting and bending (Waldron 1991a; Mays 2007). More women exhibited spondylolysis in the South than men, a pattern that was reversed in the Central Belt. Both sexes were therefore under similar strain regarding activity that required loading of the spine. Only a single case of clay shoveller's fracture was apparent in an old adult male from a funerary site of the Central Belt. Although the injury is informative in terms of injury mechanism, as the name suggests, it is not representative and remains an exception. Schmorl's nodes were reported in only 2.1 per cent of individuals in the East, compared to 8.1 per cent in the Central Belt, and 11.9 per cent in the South, which is statistically significant (X^2=19.08, p<0.001, d.f.=2). Schmorl's nodes would form as early as adolescence in response to spinal strain (Dar *et al.* 2010). The result is probably influenced by preservation and recording of lesions, as spinal strain was certainly present in select groups of the East, particularly young men from Chignal St James villa, a witness to perhaps strenuous physical labour at the site that required participation from an early age. Schmorl's nodes affected both sexes and were reported at most settlement types. Overall, the distribution of joint stress suggests that physical activity and associated strain on the bones and joints were a common occurrence in Romano-British rural life.

As expected, the frequency of degenerative joint disease increased with advancing age. However, 10.0 per cent of young adults in the South were already affected by degenerative changes, compared to 16.0 per cent of young adults in the East, and 20.0 per cent in the Central Belt. An early onset of joint disease may indicate strenuous activity undertaken from an early age. In line with a physically active population undertaking a range of occupations, we see spinal degeneration most prominently, followed by joint disease in the hip (9.3 per cent) and shoulder (8.8 per cent) in the East and South, and the hip (6.5 per cent) and hand (5.5 per cent) in the Central Belt. These very broad patterns are generally mimicked at the site level, although joint disease in the knee was high in the village site at Gill Mill, Ducklington, Oxfordshire, in the Central Belt. Comparison with urban populations may be fruitful in this context. At Butt Road, Colchester, spinal degeneration affected 13.0 per cent of the adult population (Pinter-Bellows 1993), similar to the 16.0 per cent of adults reported with spinal joint disease in the East, though less than the 27.6 per cent in the South and 26.9 per cent in the Central Belt. Some settlement types of the East follow the pattern from the South and Central Belt regions, i.e. farmsteads (21.6 per cent) and the only village site at RAF Lakenheath, Caudle Head Mere, Suffolk (25.0 per cent). For Roman Britain overall, Roberts and Cox (2003, 148–9) reported on 56 individuals (N=2664, CPR 2.1 per cent) with joint disease in the shoulder, 96 in the hip (N=3289, CPR 2.9 per cent), and 78 in the hand (N=2911, CPR 2.7 per cent). The data by Roberts and Cox (2003) yields lower prevalence rates than those reported for the rural regions. Their data are primarily based on urban populations, and the discrepant rates are perhaps a result of greater wear and tear on the joints of the spine, hips, shoulders and hands of the rural population.

General variation in the location of joint disease exists between the sexes, where women showed higher rates for degeneration of the upper limbs than men across the regions. In the Central Belt, we see significantly fewer women with joint disease than men, and degeneration at the sterno-clavicular joint was significantly higher in women of the South. Repetitive work and subsequent stress on the shoulders, arms and hands more frequently applied to the women (Stock 1991). This may be indicative of certain divisions in activity, and perhaps labour, between the sexes.

The adult population: summary

An important observation of this study is the poor availability of adult skeletons from villa sites, with the health of the inhabitants at this particular site type remaining largely unstudied. Chignal St James in Essex provides the only sample from a villa with a meaningful adult, as opposed to perinate and infant, population. We must therefore remain cautious and cannot assume that the high rates of lesions, trauma and joint disease at this site are representative of villas across the province.

As expected, there was a higher number of young adult females across all the regions, likely to be the result of the risks associated with childbirth and multiple pregnancies. Old age was attained by both men and women, and across all regions and settlement types. Contrary to what we often assume about past societies, rural Roman Britons were able to live into older age (46 years +). Not only does this inform about life expectancy in rural Roman Britain, but also reminds us of social and familial structures. Some of these older individuals may have been elderly and were cared for by their community or family.

Interestingly, we may be seeing evidence for malaria in the South, particularly around the Kent and Essex marshlands, although this should not come as a surprise, as it has been suggested previously that malaria was endemic in Roman Britain. This would have primarily applied to the marshes of the South, the Fenlands in the East and the Severn estuary wetlands. However, skeletal populations from the latter two areas are minimal. Those included in this study from the Fens were not displaying haematopoietic lesions and new bone formation to the extent we would anticipate in a region with endemic malaria. Rather than evidence of absence, we should be approaching this as absence of evidence as the adult sample from the region was particularly small.

Low-quality, particle-polluted air may have been a problem at times, as demonstrated by the presence of new bone formation on the pleural aspect of the ribs and sinusitis. Respiratory disease affected fewer individuals than it did in urban environments, but it nevertheless attests to perhaps industrial activity in smoke-filled environments, and time spent in domestic dwellings with smoke from the hearth. Non-specific bone infection was low in rural Roman Britain, but we see examples of tuberculosis infection across the regions, and leprosy was apparent in late Roman Somerset and late Iron Age/early Roman Essex. These diseases attest to crowded and unsanitary living conditions, where frequent contact with infected persons was common. Tuberculosis would have also been contracted through ingestion of infected animal products, and seems to have occurred more frequently in the South where cattle dairying may have been undertaken more intensively. The case of tuberculoid leprosy at West Thurrock, Essex, is of particular interest, as this old adult male would mark the earliest case of the disease in Roman Britain, and confirms the antiquity of leprosy in the British Isles.

The incidence of metabolic disease in rural Roman Britons was low overall, although, as expected, loss in bone density, reported as osteoporosis, was observed in a small number of older individuals. The aetiology of this condition includes calcium and vitamin deficiency, the latter also being observed in older adults in the Central Belt. Immobilisation, reliance on care, complications when eating and prolonged periods spent indoors may have contributed to both osteoporosis and osteomalacia in this context. We see further evidence for shortcomings in diet and inadequate exposure to sunlight, concentrated in settlements in Gloucestershire and Somerset, more specifically the roadside settlement at Bourton-on-the-Water and Cannington cemetery. At times, healed rickets was observed, attesting to a childhood episode of vitamin D or calcium deficiency. Scurvy in older individuals may be a result of complications when eating, where dietary intake of foods containing vitamin C is restricted. At the other end of the spectrum, two old adult males from the East Kent Access excavations were reported with DISH, which is related to obesity and diabetes. This suggests that rich diets were also consumed in rural Roman Britain, reminding us of status differences within the rural population. Dental disease rates are a further facet in the discussion of diet in rural Roman Britain. Although variation in dental disease rates was observed between the settlement types of the Central Belt and East, a relatively similar diet may have been eaten across rural sites. However, dental disease was elevated in settlements of the South, perhaps a direct result of more intensive milling in the region. Inhabitants of southern sites may therefore have eaten a more refined diet, which increases carious lesion frequency and associated dental pathologies such as abscesses and tooth loss.

As a general observation, rural Roman Britons led active lives, as demonstrated by frequent fractures, stress and degeneration of joints. Fractures, some of which would have required considerable force, indicate accidents and perhaps work-related risks. Although skeletal injury and fractures were apparent in both sexes, men may have experienced an elevated risk of skeletal trauma. Traumatic evidence for inter-personal violence and the use of weapons was reported in both men and women, which raises questions on abuse or participation in combat. An identification of the specific activities undertaken by the men and women in the countryside is beyond the remit of the study, but we see degeneration and stress affecting the joints of rural Roman Britons from a young age. Lesions were apparent in every region and a broad range of settlement types, which confirms that this would have been a physically active population involved in agricultural and domestic labour.

RURAL PEOPLE IN PERSPECTIVE: IRON AGE PARALLELS AND CONTEMPORARY URBAN–RURAL DIFFERENCES

Before moving on to any concluding thoughts on health and disease in the countryside of Roman Britain, we ought to contextualise the dataset used for study. The adult sample was therefore tested against the published results for contemporary adults from the 2000–2005 Oxford Archaeology excavations at Lankhills, Winchester in Hampshire (Booth *et al.* 2010), and Roberts and Cox' (2003) observations on pathology in adults from Iron Age Britain. The latter is a sample entirely composed of sexed adults only, which impacted on the sample size available for comparison. Nevertheless, this is the only and most comprehensive set of adult palaeopathology data for the period. Naturally, by comparing the rural Romano-British sample to the bioarchaeological data obtained from the Lankhills cemetery, we must be aware that the urban sample is composed of a single site only. This may lead to site-specific patterns being compared to a broad regional sample.

Some very broad but interesting patterns are observed in the distribution of disease within adults from rural Roman contexts, contemporary urban contexts, and those from Iron Age sites. Perhaps the most striking observation is that the variety and frequency of pathological lesions increased considerably between the Iron Age and later rural Romano-British populations. Similarly, the buried dead from rural contexts have a greater range of pathological lesions than those from late Roman Winchester. We have to bear in mind that these differences may be a result of smaller sample sizes for the Iron Age (n=398) and Roman urban (n=220) samples.

Early childhood bio-cultural stress resulting in the disruption of enamel deposition for tooth crown formation increased over time, with the highest rate reported from the urban cohort (22.7 per cent). To an extent, stress in early childhood may have correlated with socio-cultural and environmental changes brought about by Roman administration generally, and urbanisation more specifically (Addyman 1989). This confirms previous research on the urban living environment as unsanitary and unfavourable (Lewis 2010; 2012). Rates of cribra orbitalia as a result of childhood haematopoietic stress remain relatively constant across the Iron Age (4.8 per cent) and rural Roman Britain (6.6 per cent), but increase in an urban living environment (11.8 per cent). Blood-borne diseases resulting from mal- or under-nutrition, along with parasites or infections, may have affected rural Roman and preceding Iron Age populations to a similar extent, while iron-deficiency anaemia, or vitamin B6/B12 deficiency, affected the residents of towns at a more pressing scale (Holland and O'Brien 1997; Facchini *et al.* 2004; Mahmud *et al.* 2013). Again, this may be a result of more health hazards in the urban environment. However, we also have to take into account the possibility that fewer rural children lived through these stresses to acquire lesions and display them as adults (Wood *et al.* 1992; Wright and Yoder 2003).

Similar rates in rib periostitis may be a result of respiratory infections occurring at a somewhat constant rate over time, including conditions such as pneumonia or bronchitis (Roberts *et al.* 1994; Santos and Roberts 2001; Matos and Santos 2006). However, upper respiratory tract infections leading to sinusitis were only identified in the Roman period, which suggests a change in the exposure to air pollution with the Roman conquest (Lanza and Kennedy 1997; Bhattacharyya 2009). This may have been linked to occupational risks that required time to be spent in particle-polluted air, or smoke-filled domestic dwellings (see Ch. 3, p. 55). As demonstrated by the significantly lower rates of sinusitis on rural sites, upper respiratory tract infections may have been more frequent at Roman Winchester than in the countryside (Roberts 2007). Air pollution may have affected Winchester residents to a greater degree, perhaps owing to more intensive industrial activity. In contrast, however, 2.4 per cent of the adults at Butt Road, Colchester, were reported with sinusitis (Pinter-Bellows 1993), which is only marginally higher than the 1.1 per cent of affected individuals from rural sites. Discrepant results may have arisen owing to varying preservation conditions, and differing methods for recording sinusitis (Liebe-Harkort 2012). However, we have to take into account that air pollution, and therefore respiratory infections, may have varied depending on site-specific industrial and living environments.

Contrary to what we would expect, evidence for infection in the form of endocranial lesions, osteomyelitis, leprosy and tuberculosis, was absent among the Winchester adults. Bone infection, and conditions that lead to the inflammation of the dura mater surrounding the brain, such as meningitis, may have been more frequent in a rural environment (Schultz 2003). Similar, albeit low, rates of endocranial lesions and osteitis were reported from rural Roman and Iron Age sites, suggesting that non-specific infection may have been a low but steady risk. Since tuberculosis can be transmitted from animal to human, we would expect to encounter the disease in a rural environment (Grange 2001; Shitaye *et al.* 2007). However, human to human transmission in the crowded and unsanitary living quarters of Roman Winchester could also be anticipated (Roberts and Buikstra 2003). Although no skeletal evidence for the disease was brought forward in the adults, a diagnosis for tuberculosis is suggested in a 6–7 year old child from Lankhills (Clough and Boyle 2010, 388). Childhood tuberculosis informs on the ongoing rate of transmission of the infection within a population and suggests an adult pool with the disease (Nelson and Wells 2004). However, in the absence of any skeletal evidence for tuberculosis in the Winchester adults, the results suggest a greater threat of tuberculosis infection on rural sites.

Leprosy may have been a new and emerging disease that was introduced with increasing contact with populations on the Continent. The disease remains rare in the Romano-British skeletal record, with only two cases from the urban sites of Cirencester, Gloucestershire, and Poundbury Camp, Dorchester, Dorset, reported to date (Reader 1974; Manchester and Roberts 1986). Finding leprosy on rural sites may indicate that the disease was more widespread than previously anticipated. However, those with leprosy may have travelled with the disease and contracted it elsewhere.

Both porotic hyperostosis and vitamin C deficiency were absent at Lankhills, and vitamin D deficiency occurred at similar rates in the town and the countryside. If we use porotic hyperostosis as an indicator for blood-borne disease arising from iron-deficiency anaemia or vitamin B9/B12 deficiency, these differences may indicate a degree of dietary variation between town and country. Rural populations may have relied on a more plant-based diet, with greater pathogen load, parasitic infections and diarrhoeal disease (Walker *et al.* 2009; Oxenham and Cavill 2010). The fact that vitamin C deficiency was not reported from the urban context suggests that adequate resources in the form of fresh produce, i.e. fruits and vegetables, were available to the population at Winchester. In contrast, a small number of rural residents had skeletal signs that may be indicative of the deficiency. These could have arisen from a variety of possible causes, including difficulty eating, religious practices, fussy eaters or illness that required higher intake of the vitamin (Halcrow *et al.* 2014). Additionally, access to resources may have been restricted at times, impacting on the foods available to the men and women of rural settlements (Crandall and Klaus 2014; Stark 2014). The absence of metabolic disease in the Iron Age further attests to unequal resource distribution between the later urban and rural populations.

Dietary variation could have also caused the apparent differences in the distribution of dental disease. Sugar would have been accessible in the forms of *sapa/defrutum*, fruit and fruit juices, honey as the main sweetener in contemporary cuisine, and in the form of refined carbohydrates as finely milled grains (Moore and Corbett 1973; Roberts and Cox 2003, 129; Cool 2006, 67–8; Carreck 2008; Alcock 2010, 29–30; Crane 2013, 251). We assume that these foods were less frequently eaten by the population in the countryside, which should be reflected in dental disease rates (Rohnbogner and Lewis 2016b). Yet, intensive milling may have taken place in the South (Shaffrey 2015), potentially impacting on dental disease rates in the countryside. The rural population must have undergone considerable dietary change between the Iron Age and Roman period to yield significantly higher rates of tooth decay, calculus deposits and tooth loss (Hillson 1996). More refined carbohydrates, softer foods, and foodstuffs with higher sugar content, may have been eaten during the Roman occupation. Honey would not only have been the main sweetener but also used for its medicinal properties (Baker 2016; Lodwick 2017c, 81). This is further amplified in the urban settlement, as caries and subsequent tooth loss were significantly elevated at Lankhills. The adults at Winchester presented a caries rate of 37.7 per cent, compared to 26.9 per cent in the rural sample, possibly a reflection of the link between caries prevalence and urbanisation (Miura *et al.* 1997). Perhaps fruit, refined carbohydrates and honey were economically important foods reserved for trade, therefore more accessible in towns and less often eaten in the countryside. Altogether, along with the relatively high incidence of metabolic disease, it seems likely that the occupants of the countryside of Roman Britain had a less adequate diet than during the Iron Age, and also when compared with the inhabitants of urban centres, or Winchester at least. This signals a decline in diet over time, while also highlighting the stratified nature of access to resources in Romano-British society.

Activity patterns may have changed since the Iron Age, as the men and women of rural Roman Britain presented with more Schmorl's nodes. Lesions stem from continuous stress on the spine during adolescence and early adulthood (Plomp *et al.* 2012). This pattern was amplified for Roman Winchester. Similar observations were made for the prevalence of spondylolysis, with stress fractures in the spine being most frequent in the Lankhills sample. Overall, the results may indicate an even greater spinal strain on young people on this site, and perhaps an early start to continuous loading of the spine, which may have been an occupational risk.

Spinal joint disease actually decreased from the Iron Age (32.7 per cent), but rural Roman Britons (25.6 per cent) were more likely to suffer from spinal degeneration than their urban peers (21.8 per cent). At Butt Road, Colchester, spinal degeneration was in fact even lower at 13.0 per cent (Pinter-Bellows 1993). Rural inhabitants of all regions were more predisposed to spinal degeneration, which may be a result of strenuous activity and general joint stress. Joint disease in the shoulder, hip and knee affected rural Roman Britons to the greatest extent. Although we see that Iron Age populations endured considerable wear and tear to their spines, later rural residents were experiencing greater strain on their upper and lower limbs. This may well be related to increases in agricultural production during the Roman period, as outlined in Volume 2 (Allen *et al.* 2017), which would have created a greater burden on manpower. Ultimately this may have led to greater strain on the joints of the rural population. When comparing these patterns to urban Winchester, it is apparent that activity and labour may have differed between town and country, perhaps a reflection of the different occupations held by town dwellers and rural residents.

The rural people in perspective: summary

The comparison of trends in the palaeopathology of Iron Age, rural Romano-British and urban Romano-British adults has yielded some fruitful insights. Generally, elevated levels of pathology are reported from rural Roman Britain compared to Iron Age populations, indicative of a decline in health. Bio-cultural stress may have increased during Roman rule, which also came with greater stress on the joints of the rural population, a more refined but less wholesome diet, and higher rates of infection. In some respects, these decreases in health were further amplified in the urban environment at Roman Winchester. Here, respiratory infections were on the rise, although non-specific infections and tuberculosis were more frequent on rural settlements. Access to resources in the form of certain foods may have differed between town and country, reflected in the differences in dental pathology and metabolic disease. Previously, the urban Romano-British living environment was believed to be responsible for adverse effects on health. Ill-health did in fact extend beyond the city walls, as demonstrated by this brief comparison, and rural Romano-British populations may have experienced greater stress and unfavourable conditions overall. Contrary to popular belief, the countryside may not have provided a significantly better living environment, perhaps reflecting the social status of the peasant population.

Future work is strongly recommended to contextualise the findings of this chapter. Comparison with bioarchaeological data from rural, particularly early medieval sites collated in a similar fashion would be very welcome. Similar to the Roman period, the general population of the medieval countryside has received considerably less attention than their urban and high-born counterparts.

CONCLUSIONS

Osteological data for 2717 individuals from 102 settlements of early to late Roman date were observed from the South, East and Central Belt regions. The majority of these were late Roman. Sample sizes varied between the regions, with 1654 individuals reported from Central Belt sites, 741 from the South and 322 from the East. Only sites with a report date of 1995 and later, and with a minimum number of 10 individuals, were included. This covered the more in-depth anthropological data reported since the mid-1990s and enabled faster recording of a bigger sample. Nevertheless, the detail of the bioarchaeological and particularly palaeopathological data varied greatly between reports, especially for non-adults. The analysis presented here is, therefore, restricted to a discussion of crude prevalence rates only. No doubt a more detailed and in-depth analysis would allow for the observation of much more nuanced patterns in ill-health, and therefore lifeways, between men and women, adults and children, and the populations of different types of settlement.

Despite the limitations, this study utilises the largest and most comprehensive osteological dataset for rural Roman Britain to date. The data allow us to put a more personal note on the people who lived and worked in the countryside of Roman Britain. A number of important new observations are further helping us to understand the rural living environment, diet and the range of daily stressors that impacted on wellbeing in the countryside.

An effort was made to evaluate the relationship between different burial rites and the age, sex and palaeopathology of rural Roman Britons. Differential burial rites for infants are apparent, characterised by exclusion from formal cemetery areas, inhumation in dedicated infant burial clusters, and intra-mural burial. The relative frequency of infant burials varied by region, settlement type and phase, from a complete absence of perinates and older infants, to accounting for almost the entire buried population of a site. These vastly different rates suggest changing attitudes towards death in infancy, and particularly around the time of birth. The motivations behind the decision to exclude the youngest children from formal cemeteries, bury them within the settlement, or reserve a dedicated infant burial site, may have been complex. It is likely that these practices reflect a mix of local, regional and imported social, cultural and religious beliefs.

It is only in the Central Belt where a relationship between burial practice, in this case decapitation, and palaeopathology is apparent. Decapitated individuals in the Central Belt tended to show higher rates of skeletal trauma, enamel hypoplasia and caries. This would attest to higher rates of bio-cultural stress in childhood, exposure to accidents and hazardous activity, and poor oral health, linked with the consumption of soft and refined carbohydrate-rich foods. These indications may suggest a generally lower social status for the decapitated cohort. In the South region, those buried with grave goods were less likely to exhibit enamel hypoplasia. This may attest to fewer episodes of stress in early childhood of those awarded grave goods, perhaps a reflection of higher status having a positive effect on childhood health. In children, grave goods may have been given in association with milestones in the lifecourse, such as weaning and perhaps the transition into working life.

A common link between prone body position, decapitation and the presence of grave goods was that they were all more frequent in individuals of older age. Although this may suggest some correlation between people's age and the types of burial treatment to be expected in Romano-British rural society, it has to be emphasised that a range of physical attributes of the deceased may have influenced a community's decision to bury an individual in a certain way, which is not always manifested osteologically. Burial rites would have been chosen carefully by the community, and 'unusual' rites are associated with individuals demonstrating a range of ages, sexes and palaeopathological lesions.

The palaeopathology of the children (0–17 years) allows us to explore important developmental milestones in the childhood experience, while providing a multi-faceted resource for the study of health and disease in the countryside of Roman Britain. Lesion frequencies in the children were low overall, probably a result of recording and reporting of non-adult skeletons and pathological changes. Elevated levels in mortality and morbidity are apparent in 1.1–2.5 year olds, and 2.6–6.5 year olds. These remind us of the dangers that come with the introduction of supplementary feeding and the cessation of breast milk in the childhood diet. Weanlings endured infection, haematopoietic disorders and metabolic disease, which prompted elevated mortality. Inadequate weaning strategies and foods may have been in place, and the mothers themselves may have been nutritionally deprived. The weaning process would have been culturally mediated, and may have been an amalgamation of Roman and native practices. We have to bear in mind that the children we are basing our observations on were those who did not survive the weaning period and are therefore likely to show maladaptive practices. Practices may have been Roman or native in origin, and would have been influenced by individual characteristics of mother and child, their environment and access to resources. Although we should refrain from generalising too much, we do see that many rural Romano-British weanlings were exposed to pathogens and inadequate nutrition once breast milk was supplemented.

Older children of the South, East and Central Belt regions experienced a range of health problems, albeit at relatively low frequencies. Unexpectedly, metabolic disease affected children in the Central Belt, particularly from Somerset and Gloucestershire sites. We have to consider that these may have been children affected by a range of conditions that yield secondary vitamin C deficiency. Equally, resource stress may have affected these children more severely than their peers, resulting in scurvy as a result of a lack of fresh fruits and vegetables in the diet. In comparison to a sample of children from urban sites, the simpler diet of the rural cohort translates into discrepant rates of dental disease. Ultimately this may attest to a lower social status of rural children. From the age of 6.6–10.5 years, slightly elevated rates in morbidity and mortality suggest a shift in the childhood experience. It is likely that adverse health effects in these age groups are due to the early start of working lives in the countryside.

Within the corpus of adult burials, older ages were attained across a range of settlement types in every region. Mortality rates are slightly elevated for young adult females, which may be a product of the dangers of pregnancy and childbirth. Similar to the children, some regional variations in the prevalence of certain diseases are apparent. Interestingly, we see osteological evidence for malaria in the South. Within the region, the adult population sustained significantly more lesions indicative of haematopoietic disease than the children. Although the Kent and Essex marshlands provide favourable conditions for malaria, higher levels of cribra orbitalia may also stem from migration of adult individuals to the area.

The living environment in rural Roman Britain permitted infections to spread. Although non-specific bone infections, leprosy and tuberculosis were rare, they highlight an existing threat for contamination, lack of hygiene and potentially crowded living quarters. Tuberculosis was certainly more widespread than anticipated, particularly in the South. It is likely that a relationship between tuberculosis infection in humans and animal husbandry existed in the region. The earliest diagnosis to date for leprosy in the Romano-British skeletal record also stems from a rural site, late Iron Age/early Roman West Thurrock in Essex. Although this is only an isolated find, it may pinpoint the antiquity of the disease in Roman Britain, which affected rural and urban residents alike. Other respiratory ailments yielding inflammation of the maxillary and frontal sinuses or pleural aspects of the ribs were equally rare.

However, the inhabitants at the roadside settlement at Higham Ferrers, Northamptonshire, and the villa at Itter Crescent, Peterborough, in Cambridgeshire, were more predisposed to sinusitis than elsewhere. Particle-polluted air leading to upper respiratory tract infections may have been a product of hearths in living quarters or occupational hazards at these sites.

The presence of metabolic disease in the adults from certain parts of the Central Belt region is approximately coterminous with the areas where children were affected by rickets and scurvy. Some of these adult individuals were affected by shortages of sunlight or calcium in childhood, whereas others may have acquired vitamin D or vitamin C deficiencies as a result of old age. Similarly, osteoporosis was predominantly identified in old adults. In contrast to deficiency diseases, DISH was noted in two old adult males from a funerary site and farmstead along the East Kent Access. This type of spinal hyperostosis is linked with obesity and diabetes, attesting to a rich diet. Perhaps these men were distinguished members of Romano-British rural society, although we cannot rule out immigration.

Dental disease rates reveal a fairly uniform diet across the regions and settlement types of the East and Central Belt. The South is characterised by proportionately more individuals with caries and abscesses/periapical lesions. Tooth decay and associated pathologies arise more frequently with the consumption of refined carbohydrates and softer foods. Caries may have progressed more rapidly in the region due to the greater availability of finely milled flour as an everyday staple.

Skeletal injury, joint stress and joint degeneration attest to a physically active population. We cannot pinpoint the specific activity patterns of the men and women living and working in rural Roman Britain, but stress, injury and degeneration affected both sexes from a young age, and were seen across all regions and all site types. Spines, hips, shoulders, hands and knees were mostly affected by joint degeneration, perhaps influenced by the heavy demands of agricultural labour. Generally, joint disease affected the men more severely, yet the upper limbs of women seemed to be more prone to degeneration than those of the men. It is likely that different activities were undertaken according to sex, which placed distinct stresses on the skeletons of men and women.

In comparison with Iron Age and Romano-British urban adults, significant shortcomings in the health of the adult residents of the countryside become apparent. A considerable decline in health, measured as a significant increase in the frequency and variety of pathological lesions between the Iron Age and rural Roman Britain, was reported. The literature often focuses on the urban environment as the harbour for ill-health in Roman Britain, being the antithesis of Iron Age lifeways. Although it is often assumed that Roman rural lifeways were not too far removed from those of earlier Iron Age populations, the Roman occupation marked a significant change for the wellbeing of the men and women of the countryside. Furthermore, in comparison with urban populations, as represented by burials from Lankhills, Winchester, rural living appears to have had even more deleterious effects on health. Surprisingly, the rural settlements of the East, South and Central Belt regions were characterised by a higher rate of infections, metabolic disease, and joint degeneration. Some environmental pressures may have been amplified on rural sites, perhaps exacerbated by the demands of physical labour and at times inadequate diet and resource allocation.

Rural life was certainly not without a number of problems regarding health, but equally, it is clear that at least some of the population was managing reasonably well. In other cases this is not so apparent, as, for example, with the vitamin C deficiency in the children of the Central Belt. We see a population with tuberculosis and other infections, early childhood stress, nutritional deficiencies, work-related injuries, degeneration and stress on joints. Living quarters and working environments may have been polluted and crowded, and access to food and resources perhaps restricted.