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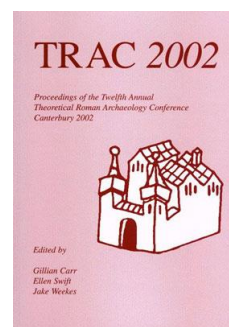
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# Sex and the City: A biocultural investigation into female health in Roman Britain

*Rebecca Redfern*

## *Introduction*

The examination of the effects of urbanism on the health of archaeological populations has not been exhausted within Britain, with little integrated work attempted on Romano-British populations (for example, London). Therefore, this study aimed to investigate whether the Romano-British urban environment and culture can be reflected in the remains of individuals buried in urban cemeteries dating from the second to fourth centuries AD. However, due to time restraints, the paucity of readily available rural data, and the limited excavations surrounding rural cemeteries, it must be considered that the osseous changes seen in the cemetery populations discussed in this paper may not have been specifically caused by urban environments.

The study of this period is important because not only is there a wide variety of source material, but also because it was during the Roman period that urbanism developed for the first time in Britain. This introduced the native population to a new set of pathogens, diet, medical care, hygiene, sanitation, and living conditions. It was also undertaken in order to improve the understanding of Romano-British health, which for too long has rested upon the Poundbury Camp (Dorset) and Cirencester (Gloucestershire) data sets. Understanding past communities cannot be achieved without considering their health statuses. This can be achieved through palaeopathological analysis, which permits a direct, unequivocal understanding and analysis of the well being of our ancestors. Recently there have been calls to fully integrate palaeopathological evidence, especially by Esmonde Cleary, who has emphasised this need within his frequent papers on cemeteries. In his words, "palaeopathology has yet to be deployed to full effect in the study of Romano-British material" (1992: 29).

The study within this paper combines palaeopathological data with a gendered reading of the archaeological evidence, and also considers bioarchaeological evidence of the living environment to investigate the health statuses of urban dwellers. This information is set in a biocultural framework which is defined as "[one which assesses] the biological condition of human populations ... its consequences for the biological and cultural reproduction of the society ... to consider the selective effects of culture on the population under study and its survival" (Bush and Zvelebil 1991: 5). As interpretations of health are given within a cultural context, this provides some control over which interpretations are valid (Ortner 1992: 8; Wood et al. 1992: 358), as does the integration of bioarchaeological data (Bush 1991: 6).

This investigation has several interpretational problems. First, the cemeteries were used for long periods of time and, therefore, the information regarding health from these samples represents the whole of the Roman occupation. Second, who was living in towns and from where did they come? Unfortunately, this will not and cannot be answered unless ancient deoxyribonucleic acid (aDNA) and isotopic analyses are undertaken on all skeletal material from this period. We must, therefore, consider that some individuals buried in the urban cemeteries lived a rural way of life.

## Methods

### Archaeological Context

Table 1: Total number of individuals used in study.

Cemetery	Male	Probable Male	Female	Probable Female	Total
Colchester	171	6	129	17	323
Chichester	19	9	12	2	42
Ilchester	–	28	13	2	43
York	311	21	42	17	391
Poundbury Camp	251	–	226	1	478
Cirencester	220	9	78	15	322
London	96	17	36	12	161
Total	1068	90	536	66	

Table 2: Examples of rural palaeopathology from Dorset (unsexed and unsexable adult data excluded)

Cemetery	Periosteal Reaction	Tuberculosis	Fractures	Cribriform orbitalia	Lack of osseous change	Total
Tolpuddle Ballm (McKinley 1999)	3 females, 2 males	1 male	1 female, 2 males	2 males and 1 female	13 individuals	16 females 10 males
Southern By-Pass (Rogers 1997)	1 male		3 females 1 male		6 females and 2 males	9 females 6 males
Western Link (Jenkins 1997)					1 females and 2 males	3 females 5 males

In the preliminary research for this analysis, it was hoped that changes through time could be identified by examining each century individually in order to emphasise the urban development and fluctuating numbers of urban dwellers. However, due to the difficulties of dating some inhumations and the problems of splitting material temporally, this was not possible. It was also initially proposed to compare urban and rural cemeteries, but there was a lack of available excavation reports of sufficient detail, and the time constraints governing research did not permit the collation of rural cemetery data from archives. Despite this, data from just three rural cemeteries in Dorset was collected as a sample study. Table 2 shows the incidence of disease in these cemeteries. Current research by the author will also investigate health changes in Dorset from the Iron Age to the post-Roman period to address rural / urban health differences in the Romano-British period (see Redfern 2002). It should also be mentioned here that cremated and disarticulated material were excluded from analyses in this paper due to disparities of publication, analysis and identification of pathology (McKinley

2000: 413), unclear contexts, and because the total numbers of individuals from sites were frequently not calculated using this data.

### *Data Collection*

The data was collected from information published in the microfiches of site and specialist reports (where available). The London data set was sourced directly from the Museum of London Archaeology Service Archive. These sites were chosen because they were fully published (or available), and they are acknowledged as being 'urban' centres within Roman Britain.

As different authors published the data, the disparities between each report were evident. This was especially noticeable in the level of detail in the descriptions and in the inclusion or omission of necessary data, particularly for dental disease. Therefore, in order to use the data, the information was separated using the age categories described by Scheuer and Black (2000: 469), where 'infants' are those under three years old; 'children' are three to seven years old; 'juveniles' are those of eight to ten years old; 'adolescents' are ten to twenty-two years old; and 'adults' are those over twenty-two years old. All information regarding osteological change was categorised according to Aufderheide and Rodríguez-Martin (1998). This was done in order to demonstrate the range of changes as well as the palaeopathology found during this period. In order to analyse more closely the relationship between periostitis (inflammation of the upper surface of the bone (periosteum) which leads to the laying down of new bone), enamel hypoplasia (a defect of the tooth enamel) and cribra orbitalia (pin-prick sized holes in the roof of the eye orbit, which group together and may increase in size, caused by iron deficiency and / or a parasitic infection) in the different age and sex categories, periostitis was further subdivided from infectious disease as it can also be caused by trauma (Roberts and Manchester 1999: 130). In some cases individuals were described with osteological changes that are no longer regarded as reliable within palaeopathology, and these were either re-assigned or ignored. The results of the research generated by the analysis of specialist reports are restricted for the most part by inter-observer error, as well as by constraints of publication, which limit photographs and the length of reports. The frequent lack of accurate descriptions and total number of elements have often resulted in many diagnoses being rejected because of a lack of certainty, for example, whether female vertebral body collapse was due to underlying osteoporosis or trauma (see Resnick and Niwayama 1988: 1813–1821).

Dental disease, which is recognised as an important insight into past health statuses (Freeth 2000) was excluded from this analysis due to the lack of data within reports regarding the total number of teeth, and the totals of left and right dentition. Consequently, it was not deemed useful to include it in this particular study; however, dental data will be included in a future study by the author examining rural and urban health.

As the research presented here seeks to find correlations between the environmental evidence for the living environment and the palaeopathology of the cemetery samples, the discussion will concentrate upon evidence for infectious and metabolic diseases, stress indicators, trauma, surgery and fractures.

### *Palaeopathological approaches*

Palaeopathology, as defined by Lovell, "aims to reconstruct the history and geography of diseases, to illuminate the interaction between disease and cultural processes, to document the evolution of diseases over time, and to understand the effect of disease processes on bone growth and development" (2000: 217). For this to be achieved, studies rely upon a wide research base, including medical anthropology, social anthropological research in traditional societies, clinical data, and inclusive studies of past populations (see McElroy and Townsend 1996; Sargent and Johnson 1996; Merbs 1983). This is also the essence of a biocultural approach as "it is only at the interface of archaeology and cultural and physical anthropology, within the framework of the biocultural approach, that the study of health in past societies can be fully developed" (Bush 1991: 7–8). For instance, an analysis of the implications of dietary stress relies upon data for both the environment and possible cultural stressors produced by the social environment (Bush 1991: 6); this data will thus be generated by anthropological and archaeological data (see Eisenberg 1991).

Roberts remarks that the interpretation of palaeopathological data cannot be undertaken unless clinical texts and data from anthropology are used (1991: 225). This approach has been proven by Jurmain's work on osteoarthritis (1999: xii); Jurmain states that the analysis of human remains must incorporate clinical and anthropological data in order for reliable interpretations to be achieved. Studies of enamel hypoplastic defects have also shown that analysis of modern clinical and anthropological data can be used to understand past prevalences (see Lukacs et al. 2001; Goodman et al. 1987) and to explain trends within prehistoric populations (Goodman and Song 1999; Goodman and Rose 1991). The use of clinical data is also central to the analysis of ancient trauma, as Walker (1997: 160) has shown that clinical literature contains valuable comparative data and models, which can be used to determine patterns of palaeo-trauma. Consequently, in this research, these sources of evidence have been used in order to attempt an inclusive understanding of the health affects of Romano-British urban environments.

As with any discipline, there are limitations to the analysis of past health. Ortner (1992: 8) has summarised that which we cannot always excavate, interpret or understand, but which are crucial in understanding health in the past:

- 1) The age at which the individual contracts the disease;
- 2) The individual's nutritional status;
- 3) The immune response of the person;
- 4) The biology of infectious agents;
- 5) The disease's portal of entry;
- 6) The effectiveness of any method of treatment;
- 7) Social conditions that can affect the transmission of disease.

These factors are further hindered by the fact that archaeological human remains reflect the osteological changes which were present / active at the time of death (Goodman 1993: 281–2). What must also be remembered is that the osseous lesions on the skeletal remains of past populations represent a small percentage of the total disease load in a population (Wood et al. 1992: 634; Waldron 1994: 36–41; Ortner et al. 1992: 337).

Palaeopathology must be used in combination with bioarchaeological evidence in order to understand the transmission of diseases, especially in urban environments; as McGrath (1992: 14) notes, human behaviour is instrumental in influencing disease transmission, and is often crucial in determining the success of vector transference.

### *Past concepts of health*

Concepts of disease and illness are socio-culturally dependant; diagnoses of disease are reliant upon what the observer believes to be significant, as well as their ideas of health and disease (see Baker and Carr 2002); for instance Hippocratic doctrines on disease transmission compared to modern understanding of microbe transmission (Armélagos et al. 1977: 72). The symptoms taken into account may be very different to our own concepts of disease causation, and what constitutes a symptom; for instance, some morbid characteristics of sickness may sometimes form part of an aesthetic ideal and are therefore ignored (Polunin 1977: 85–88) e.g. the romanticisation of tuberculosis (Roberts 2000: 52). The opinions used in diagnosing a disease may actually reflect socio-political factors affecting the social unit (Armélagos et al. 1977: 82). These concepts also impact upon the treatment and care given to individuals (Hughes 1977: 156–7; Ackerknecht 1977), especially those who may have been disabled (c.f. Roberts 2000).

Investigations of health and treatment in the Roman period have shown that there were differences in treatment and use of medical equipment depending on the part of the Empire in which you lived, where you came from, and where your doctor trained, as well as the influence of social and economic statuses of both the patient and the doctor (Fleming 2000; Jackson 2000; Baker 2001). Therefore, the care and treatment received in Roman Britain may have been very varied, reflecting individual views of health and sickness.

### *Urbanism*

Urbanism is a key area of research within Roman archaeology and palaeopathology because it is such a unique un-natural environment. Urbanism is and was created by people and subsequently influences the health of those who live in an urban environment. The effect of the urban environment on health is of great importance in understanding Romano-British urban living. Such a study has not previously been investigated following the biocultural approach presented here. Storey's examination of pre-industrial urban health highlighted many relevant points: food would have been sourced from the surrounding areas and therefore any fluctuations in quantities would have also affected urban dwellers. Many infectious diseases are transferred more easily in denser communities, and closely packed housing can lead to contamination of water supplies; furthermore, migrants into the area can act as agents of disease (Storey 1992: 33). All of these points need to be borne in mind when considering Romano-British urbanism in regard to palaeopathology.

Several works on British urbanism have been undertaken, for example Brothwell (1994: 129–136), Waldron (1989: 55–73), and Manchester (1992: 8–14). However, none has specifically focused upon the Romano-British period. The main differences between rural and urban areas are through the modes of transmission and frequencies of disease only, not the

diseases themselves (Manchester 1992: 9). Consequently, many changes seen in individuals may reflect diseases that were transmitted in rural areas and were not specifically caused by urbanism.

When investigating urbanism in past populations, data concerning migrants in developing countries can be used to understand the affects of urbanism, as exemplified in Allason-Jones' work 'Urban angst in Roman Britain' (2001 unpublished). As stated previously, the use of anthropological research is key to understanding past health statuses.

### *Romano-British urban areas*

The setting of towns has been reviewed by Salway, who notes that health was also considered during the planning phases. He cites Vitruvius's 'scientific' explanation that "if the town is on a coast and faces south or west, it will be unhealthy, because the southern sky in summer heats up as soon as the sun appears" (*De Architectura* i.4.1-6). However, as Salway admits, at the time of the Claudian invasion of Britain, Vitruvius's advice, written in the reign of Augustus, may have seemed out of date (1985: 67).

Throughout time, towns have been places of public buildings and services. Present in British towns were basilicas, theatres, shops, temples, fora and baths (de la Bédoyère 1992: 23-6), all important vectors and manipulators of disease (McGrath 1992: 16). However, this does not necessarily mean that they were *more* unhealthy than rural areas, or more likely to cause certain diseases (c.f Manchester 1992).

James's recent work which attempted to distinguish between civilian and military areas in Roman Britain has highlighted several key points which are of relevance to this research, especially concerning whether the environmental evidence from military contexts can be used to infer living conditions elsewhere in the urban areas. There is no evidence to suggest that civilians were banned from entering and living in or near fortresses. He suggests that we "must recognise that we are always dealing with a 'soldier-civilian' mix" (2001: 83-4). Therefore, we must assume that women as camp followers and 'wives' of the soldiers were exposed to the same living environment as the men, and had similar or the same access to medical treatment as men.

### *Bioarchaeological evidence for the living environment*

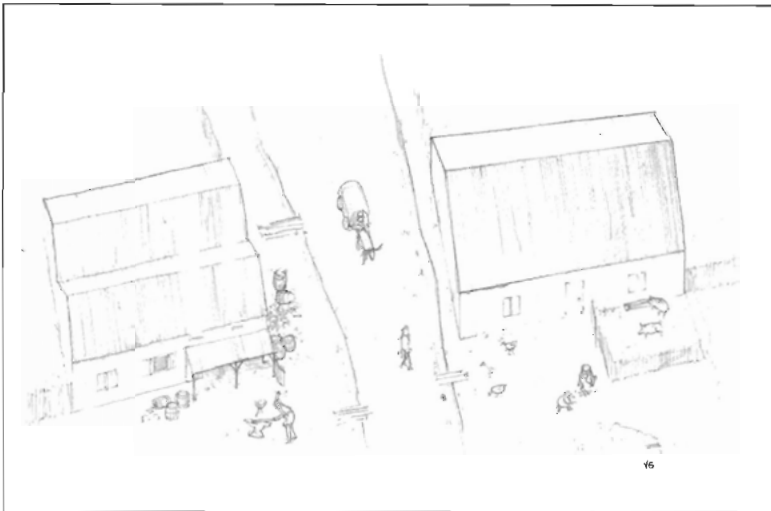
Environmental evidence is our major access point in re-creating a sense of the Roman urban environment, especially as we lack the written sources, available for Rome, which might have described British urban living (see Scobie 1986). Dobney et al.'s review of the environmental evidence from Britain demonstrates that insufficient contexts have been excavated (1999: 18-20) and, as most of the evidence has been retrieved from London and York, we are reliant upon these datasets to understand Romano-British urban environments. Therefore, it is acknowledged in this paper that this provides a biased view of the urban environment. However, unless future research and analysis is undertaken and published, this will not change.

The environmental evidence discussed in this paper uses faunal material, macro and microscopic flora remains, and entomological evidence. These are often used in collaboration with each other, following Kenward and Hall's indicator groups which are defined as "a

collection of recordable data of any kind which, when occurring together, can be accepted as evidence of some past state of activity" (1997: 665).

### *Local environment*

The local environment is an important agent in determining the health of any individual. Therefore, unless this is understood, the interpretation of the palaeopathology is limited. In this study, the definition of the local environment follows Evans and O'Connor (1999: 62 & 64). Integrated bioarchaeological data from urban areas has been characterised by an indicator group which has been interpreted to represent areas of rotting organic material composed of domestic refuse, including food remains, faecal material, fleas, lice and woodworm, with the flora indicating disturbed ground (Hall and Kenward 1995: 393).



*Figure 1. Reconstruction of Roman urban living.*

The data from 1 Poultry in London is particularly important to this study because timber buildings and plots were preserved. This dataset provides one of the most detailed available; however, as London was the capital, the results may be atypical. Data from other areas such as Dorchester or Carlisle provide a wider view and are reviewed by Dobney *et al.* (1999). Environmental samples from 1 Poultry have indicated that the homes had dumps of household rubbish in their yards in which were also kept pigs and chickens. The houses provided shelter for the black rat, which is another vector of disease. Wells were dug into the house yards to provide water for the inhabitants (Rowsome 2000: 30 & 34–5; Jackson 2000: 46); if the rubbish was able to contaminate these sources, the wells would become excellent habitats for fatal diseases such as cholera and dysentery (Roberts and Manchester 1999: 12). The effluent from animals would make the water dangerous, as coliform bacteria may develop which, if ingested can cause gastrointestinal infections (<http://www.vh.org/Patients/IHB/Peds/Safety/>



DrinkingWater/DrinkingWater.html). In other examples of living areas, such as Pompeii, latrines were often situated in kitchens (Jackson 2000: 53). This may also have been the case in Britain.

Excavations and finds from both I Poultry and Walbrook indicate that industry was not separated from domestic contexts, as people lived close to forges and tanneries, and the run-off from these industries entered the local water supply (Perring and Brigham 2000: 412–4; Jones 1980: 2; Rowsome 2000: 34). This would have exposed people to air pollutants, rotting animal carcasses and poisons.

### *Internal parasites*

The health of the urban communities is also reflected by parasite evidence (see Figure 2); at Poundbury Camp head lice and internal parasites were preserved in the plaster packing; at Carlisle a crab louse was recovered from organic layers; and, at York, deposits contained faecal material infested with whipworm and roundworm (Hall and Kenward 1995: 386; Kenward 1999). The parasites can be used to reflect urban living, where people may be living in a more faecally polluted environment compared to rural areas (Knight 1982: 91)

The preservation of head lice – still attached to hair shafts at Poundbury Camp, can be used to infer that people were also probably suffering from internal parasites, that they had poor personal hygiene, and that some may have been living in cramped conditions which were suitable for the spread of infectious diseases (Rheinhard 1992: 238).

Many individuals from Poundbury Camp with whip- and roundworms recovered from their pelvic regions (Jones 1993: 197–8) also had osseous responses associated iron deficiency (Roberts and Manchester 1999: 165–170). Stuart-Macadam's analysis of iron deficiency at the site suggests that these anaemic responses may have been caused by the parasite infestations (1991: 103 & 105). However, the creation of an anaemic response can also be produced in order to inhibit the effects of the infestation (Ryan 1997: 51; Weinberg 1992: 135–6; Stuart-Macadam 1991: 105).



Figure 2. Hair louse preserved on hair shaft from Poundbury Camp

### *Dietary evidence*

Diet is crucial in understanding the health of Romano-British urban dwellers, because it played a part in their susceptibility to disease, determined the strength of their bone tissue and, when deficient, left markers on their bones and teeth (Larsen 1999: 61; Brickley 2000: 183–198). Previous studies using bioarchaeological evidence to understand diet have been very successful, for example at Alphen aan den Rijn (Kuijper and Turner 1992). The value of an

isotopic approach has been proven at Poundbury Camp, where a study concluded that the diet was dominated to a large extent by marine resources (Richards et al. 1998: 1247–52). Food remains recovered from urban contexts have revealed a very varied diet – plums, sweet/sour cherries, walnuts, celery, wheat, crabs, mussels, garden dormice, dill, fennel, black cumin, eels, pig, cattle, fowl, sheep/goats, anise, wine from southern Gaul, honey, as well as rye, oats and barley (Dobney et al. 1999: 17–18; Davies 1971: 131–2; O'Connor 1988: 116–122; Kenward et al. 1986: 262–3; Hall and Kenward 1995: 404–409; Rowsome 2000: 30 & 36).

The bioarchaeological evidence shows that a wide variety of foodstuffs were available; however, we do not know who had access to a healthy diet, which would have provided the vitamins and minerals needed to avoid metabolic diseases. The incidence of internal parasites may be connected to food acquisition; night soil may have been used as manure and, therefore, any internal parasite eggs in the manure would have entered the food chain, or would have been transferred to agricultural workers if basic hygiene protocols were not followed (Knight 1982: 90, 93).

### *Palaeopathological evidence*

In most skeletal samples, the remains will have been affected by a variety of cultural and taphonomic processes, and are not always reflective of the population from which they are derived (Waldron 1994: 10–250). This is further complicated by the fact that we will never know individual frailty and risk of death, which will determine at what age the person could have become incorporated into the skeletal sample (Wood et al. 1992: 345). Furthermore, within any human skeletal sample, many individuals will not display any pathological changes on their skeleton – something that is known as the ‘osteological paradox’ (Wood et al. 1992: 353). The key issue of Wood et al.’s argument highlights the view that these individuals are regarded as healthy because there is no change on their skeleton, which may not actually reflect their true health status. ‘Frailer’ individuals would die before a bone response could develop (1992: 353), therefore masking the presence of a disease which may only be identifiable through aDNA analysis. Many of the ‘frailer’ individuals who had reached adulthood, would have been individuals who had suffered from stressful episodes in non-adulthood, which resulted in their poor growth and early death (Jantz and Owsley 1984; Saunders and Hoppa 1993; Humphrey 1998; 2000). This has been shown in a palaeopathological and clinical study, which proved that “poor early growth does appear to generally predict decreased adult health” (Clark et al. 1986: 152).

Table 3: Lack of an osseous response

Cemetery	Female	Probable female	Male	Probable Male
Cirencester	10/78 (13%)	5/15 (33%)	36/207 (16%)	3/9 (33%)
Poundbury Camp	4/226 (2%)	–	4/251 (2%)	–
Colchester	33/129 (26%)	8/17 (6%)	49/171 (29%)	3/6 (50%)
Ilchester	2/2 (100%)	5/13 (38%)	–	10/28 (36%)
Chichester	11/12 (92%)	–	14/19 (74%)	3/9 (50%)
London	5/36 (14%)	8/12 (67%)	14/96 (15%)	4/17 (24%)
York	32/42 (76%)	13/21 (76%)	149/311 (48%)	13/21 (62%)

Within the chosen sample of Table 3, the numbers of females in this category are low. This may be due to various factors such as:

- 1) A lack of urban cemeteries which have been completely defined and excavated;
- 2) The cultural separation of women from urban cemeteries or their burials in less visible spaces (Davison 2000: 234);
- 3) Inter-observer error in diagnosis (see Lovell 2000; Buikstra and Ubelaker 1994: 183–4);
- 4) The use of older methods.

### *Stress indicators*

Selye has defined stress as an anthropological concept, as “the state manifested by a specific syndrome which consists of all the non-specifically induced changes within a biological system. Thus, stress has its own characteristic form and composition but no particular cause” (1957: 54, cited in Bush 1991: 14). In palaeopathology, stress is investigated by using a combination of three osseous changes – cribra orbitalia, periostitis and enamel hypoplastic defects (for complete aetiologies see Aufderheide and Rodriguez-Martin 1998; Larsen 1999: 29–61). The female prevalence can be used to interpret the palaeopathology seen in the infant sample. In this study, the number of females affected was lower than the males (see Table 4), but a chi-squared statistical test (only undertaken on the stress indicators, to test significance at 5% = 9.49, as this had sufficient data necessary for the test) showed that the females levels were as significant, thereby supporting the hypothesis that urban living may have been stressful and often detrimental to health, whatever the sex.

The act of migration from other parts of the Empire or from within Britain may have created stress; women were known to have travelled with the army as wives, such as Sulpicia Lepidina who lived at Vindolanda (Birley 1995: 20). Epigraphic analyses have also shown that women had moved to Britain; a gravestone from Netherby stated that Titullinia Pussitta had originally come from Raetia (Allason-Jones 1989: 64). Isotopic work at Poundbury Camp has shown that two females had probably spent most of their lives in a warmer climate (Richards et al. 1998: 1251).

Table 4: Stress indicators

Cemetery	Periostitis	Cribra Orbitalia	Enamel Hypoplastic Defects
Cirencester	Female 5/78 (6%) Pfemale 2/15 (13%) Male 15/220 (7%)	Female 1/78 (1%) Male 9/220 (4%)	Female 8/78 (10%) Pmale 1/9 (11%)
Poundbury Camp	Female 20/226 (8%) Male 29/251 (12%)	Female 81/292 (27.7%) Data from Stuart-Macadam (1991, 102) Male 1/251 (0.4%)	—
Colchester	Pfemale 2/17 (2%) Male 6/171 (4%) Pmale 1/6 (17%)	Female 7/129 (5%) Male 6/171 (4%)	Female 25/129 (19%) Pfemale 1/17 (1%) Male 30/171 (18%)
London	Female 5/36 (14%) Male 9/96 (9%) Pmale 1/17 (17%)	Female 1/36 (3%) Pfemale 1/12 (8%) Male 3/96 (3%) Pmale 1/17 (6%)	Female 7/36 (19%) Pfemale 5/12 (42%) Male 18/96 (19%) Pmale 2/17 (12%)

Key: Pmale = probable male. Pfemale = probable female.

Allason-Jones' examination of the repercussions of urbanism in Roman Britain used research generated by social geography to good effect in order to "get into the minds of some of the inhabitants of Roman Britain and imagine what they were going through" (2001: 4). In this paper, medical anthropological research has been used to demonstrate the links between a new living environment and the development of disease. It is accepted that modern urban areas have a great deal more 'stress' than the Romano-British; however, trends have been noted with migration to an urban area, and it is considered that these could have been present in Romano-British urban areas – migration frequently results in a change of socio-economic status, poor living conditions and consequently a higher exposure to disease (Ehrlich et al. 1973: 40–44). The nature of urbanism during this period may have had health repercussions, as urban areas have a higher risk of physical and mental morbidity (Harrison 1980: 61). Leatherman has shown that economic and social marginality leads to poor health by increasing exposure to 'insults' (1992: 883). Bogin has shown that migration may cause stress to the individual which would alter their cortisol levels, resulting in a significantly lowered immunity and a statistically significant increase in the frequency of illness, therefore beginning an increased cycle of morbidity (1999: 395).

The low prevalence of stress indicators in the female sample may alternatively show the enhanced immune system of women compared to men, as from birth females tolerate environmental stress better than men. During childhood they can better endure diseases, and are able to withstand infectious diseases and nutritional deficiencies better than males (Ortner 1998: 81; Overfield 1995: 165–170; Stinson 1985). This is due to an evolutionary adaptive mechanism, which increases female immune reactivity so that the hazards of pregnancy, particularly infection, could be coped with (Ortner 1998: 81). It is suggested that this is why there is a lower prevalence of dental enamel hypoplastic defects in the sample.

The females in the sample suffering from cribra orbitalia may represent women within the community who were pregnant, had just given birth, or had had a succession of narrowly spaced births. During pregnancy, maternal iron demands are ignored in preference for the foetus. If the women were iron-deficient before pregnancy, then the iron levels of the foetus will be affected and they will increase their anaemic status (Palkovich 1987: 530; Ryan 1997: 35–60). Females with this change would have sustained a very low intake of iron from their diet, and would only have developed iron-deficiency anaemia after two to three years. This time may have been reduced if they suffered from a heavy parasite load, a chronic infection and/or an inflammatory condition (Stuart-Macadam 1992: 157–90). This provides a connection to the infants with cribra orbitalia and other indicators of anaemia.

It is believed that the interpretation applied to the Cannington population can be used here – that the lesions were acquired in childhood due to hard life conditions and adaptation to the environment (Robeldo et al. 1995: 190–1). However, Stuart-Macadam suggests that adult lesions, although reflecting childhood levels of non-specific infections, do not provide a true picture of the past community's health (1991: 101). It must also be stated that Stuart-Macadam, amongst others, argues that people with low iron levels have lower parasite loads, and that it may be an adaptive response to urbanism (1992: 164–5).

### *Infectious disease (tuberculosis, non-specific infections and osteomyelitis)*

Table 5: Evidence of infectious disease

Cemetery	Infectious disease	Osteomyelitis
London	Female 3/36 (8%) Pfemale 8/12 (67%)	Female 1/36
Cirencester	Female 1/78 (1%) Male 2/220 (1%)	Female 1/78
Colchester	Female 1/129 (1%) Male 1/171 (3%) Pmale 1/6 (17%)	Female 1/129 Male 1/171
Poundbury Camp	Female 4/226 (2%)	Male 1/251

Key: Pmale = probable male. Pfemale = probable female.

It can be seen from Table 5 that infectious disease prevalence was higher in females than in males. This supports Ortner's assertion that women will have higher rates of disease than men, as women will display the chronic and long-term effects of infection, due to their enhanced immune response. The women affected may have had the disease present at the time of conception, when the immune system is lowered in order to stop the foetus being rejected, enabling the disease to spread quicker and shortening the time before an osteological response was created (1998: 81 & 87–88; see earlier discussion on female immune response).

The female way of life may have played a role in the exposure to the agents of these diseases, particularly if women were responsible for the domestic environment, where cooking and sources of disease were closely associated. The low prevalence of infectious diseases, also seen in the sample, reflects individuals who were healthy enough to sustain the infection long

enough to develop an osseous response. The high prevalence in London may be the result of the local environment, which elsewhere may not have been so polluted or unhygienic.

The ability of women to sustain a serious infection over a long period can be seen in those who have evidence of osteomyelitis (see Table 5). A woman from London developed a draining abscess on her tibia, caused by pus escaping from the inside of the bone. This abscess would have required care and assistance, because her ability to walk would have been compromised. She would have suffered from fevers, weight loss, her leg would have been massively swollen, and the abscess would have to be tended and kept clean in order to avoid the introduction of more infection (Oxford Concise Dictionary 2000: 472).

Tuberculosis has been identified at Poundbury Camp, in "two or three suspected cases" (Farwell and Molleson 1992: 190), and it is proposed that if a re-evaluation using modern clinical and palaeopathological criteria was applied to the samples (see Redfern 2002), then more cases would be identified (see Santos 1999; Lagier 1999; Rothschild and Rothschild 1999; Baker 1999; Roberts et al. 1998). A re-appraisal of these cases by the author demonstrates that at least one case has the distinct changes associated with tuberculosis (Lagier 1999: 288–290). The transmitter of tuberculosis (human or bovine), can only be identified using bacteriological or genetic methods (Vincent and Perez 1999: 139); therefore, the proposition that tuberculosis may have been transmitted between individuals by the bacilli present in their breath, sputum and excreta (Roberts and Manchester 1999: 137; Vincent and Perez 1999: 140) in the urban area cannot be dismissed (Roberts pers.com).

The evidence from Poundbury Camp needs to be re-assessed using aDNA to determine the strain of tuberculosis, as recent work has shown that human and bovine tuberculosis are separate strains – therefore the human strain did not evolve from bovine tuberculosis (Brosch et al. 2002: 3684–3689).

The connection between tuberculosis and urban environments is well attested (Ortner 1999: 255). Its identification in Romano-British urban areas is important, as it demonstrates that the urban areas had a high population density, unsanitary environment and available modes of transmission in the local environment (Ortner 1999: 255). This relates to the bioarchaeological evidence for the local living environment, which is seen as being unsanitary, with waste being disposed close to living areas. The transmission of the disease to large sections of the population would be facilitated by the communal places available in an urban settlement i.e. baths and markets.

The role of migrants as vectors of tuberculosis transmission in unsanitary urban areas is also an important consideration. Recent aDNA work has shown that tuberculosis was present in Iron Age Dorset, although the aDNA was unable to determine whether the transmitter was bovine or human (Mays and Taylor 2002 pers. comm.), therefore it could have been present / sustained within the Durotrigian community into the Roman period. The rural Romano-British cemetery of Tolpuddle Ball (Dorset) included a man with spinal changes indicative of tuberculosis, and a female with periosteal new bone formation on the visceral surface of her ribs, which is an indicator of tuberculosis (Roberts et al. 1988; Kelley and Micozzi 1984; McKinley 1999a: 167–8 and McKinley 1999b: 5–6). Therefore, it is possible that these individuals may have acted as vectors of disease in Dorchester; they may have been infected in town, or may reflect the community of tuberculosis in rural populations.

*Metabolic diseases*

Table 6: Evidence of metabolic disease

Cemetery	Female	Male
Poundbury Camp	31/226 (14%)	16/251 (6%)
Colchester	1/129 (1%)	0/220
London	3/36 (8%) Pfemale 1/12 (8%)	10/96 (10%)
York	Pfemale 1/21 (6%)	0/311

Key: Pfemale = probable female.

In Table 6, osseous changes reflective of metabolic diseases in the female sample was due to cribra orbitalia and adult vitamin D deficiency which causes femoral bowing, known as osteomalacia (Brickley 2000: 189). The number of females affected was far higher than in the male sample (see Table 6). Evidence for subadult rickets was found at Poundbury Camp, where a female had bowed tibiae and flattened os coxae (Farwell and Molleson 1993: 184). The role of preferential treatment of males generally within Roman society is well attested elsewhere in the Empire (Adkins and Adkins 1998: 339). However, information for Romano-British society suggests that this was not the case and, as Roman law was interpreted locally (Allason-Jones 1989: 15 & 19), a case could be made to suggest that women had equal access to food, due to the emancipated position of women in Iron Age society (Allason-Jones 1989: 17–29) and therefore, reasons for developing metabolic diseases could have been similar.

As shown in the table, there are clear inter-site differences in the number of females affected by metabolic diseases. The reasons behind this difference may be due to differences in the local environment, in access to food, in access to military health services, and in country of origin, as it is unknown how many females may have had poor metabolic health before their inclusion in British cemeteries.

*Trauma*

Trauma was recorded in most cemeteries. Many females were reported to have vertebral body fractures; however a precise diagnosis of these fractures was difficult, as underlying factors such as osteoporosis or tuberculosis can cause this trauma (Apley and Solomon 2000: 55–57; see also Merbs 1983: 32–35). Diagnosis was compromised by the lack of radiographic analyses and accurate descriptions, which are necessary in determining an accurate diagnosis (Resnick and Niwayama 1988: 1812–22); therefore these were excluded from the results. The trauma results of Table 7 were dominated by fractures.

The highest prevalence was recorded at Poundbury Camp, which had forty-four females with fractures (see also the study of trauma on this sample by Walker (1997); this is in contrast to York, where only one female had evidence of fracture. Following Judd's analysis of the causes of trauma-related fractures, it is considered that most of the fractures resulted from encounters with the environment or through accidental fall (2000: 64–5; see also Lovell 1997: 161).

Table 7: Evidence of fracture

Cemetery	Female	Male
London	6/36 (17%)	15/96 (15%)
Cirencester	7/78 (9%)	54/220 (25%)
Poundbury Camp	44/226 (18%)	71/251 (28%)
Colchester	7/129 (5%)	16/171 (9%)
Ilchester	Pfemale 2/13 (15%)	Pmale 1/28 (4%)
York	1/42 (2%)	14/311 (5%)

Key: Pmale = probable male. Pfemale = probable female

The healing and treatment of the fractures appears to have been very satisfactory, as only one example of a disability was reported from London (see Figure 6). The disability was caused by an un-united Monteggia fracture, where both the radius and ulna are fractured, (Jurmain 1999: 219). The failure for the radius and ulna to unite could have been the result of inadequate blood supply to the site; metabolic deficiencies of vitamin D and / or C as well as calcium; trapping of soft tissue between the elements; movement of the arm before the callus had set; or due to the unstable nature of the fracture (Lovell 1997: 147). The lack of union in the forearm would have compromised the use of the arm and hand, limiting the range of tasks that she would have been able to undertake.

The conscientiousness in treatment and reduction of the fractures demonstrates a great deal of care especially where women had broken their tibia and fibula or their femur, as these are serious fractures which can lead to disruption of the blood supply therefore interrupting the healing process (Ortner and Putschar 1985: 65). The lack of secondary infection demonstrates that despite the unsanitary nature of some of the living conditions represented in the bioarchaeological record, the women may have received medical treatment (see Baker 2001; Fleming 2000; Jackson 2000; James 2000; Huber and Anderson 1996), and were cared for in a clean local environment with access to a good diet, which would have assisted adequate healing (to combat the cycle between poor nutrition and infection, see Larsen 1999: 88). As Roberts notes, "skeletal remains from cemeteries do not represent individuals who lived cocooned in isolation from their environment" (1991: 238).

Table 8: Evidence of trauma

Cemetery	Female	Male
York	1/42 (2%) Pfemale 1/21 (6%)	2/311 (1%)
London	3/36 (8%) Pfemale 1/12 (8%)	4/96 (4%)
Colchester	1/129 (1%)	1/171 (1%)
Poundbury Camp	4/226 (2%)	6/251 (2%)

Key: Pfemale = probable female.

Table 8 shows that, at Colchester, three women had evidence of blunt force cranial trauma, which may have been the result of inter-personal violence, as two are situated on the occipital, indicating that the woman may have been struck from behind by an 'aggressor'. These



fractures can also be easily caused by accidents; consequently I am in agreement with Merbs, who states that "even when damage is convincingly intentional, the actual intent may not be obvious" (1989: 187; see also Jurmain 1999: 230). It cannot be certain whether these fractures were the cause of death in these females, as no scanning electron microscopy analysis was employed to determine whether any healing had taken place before the death of the individual (Roberts 1997).

Primary evidence for surgery using Roman equipment was found at the railway site at York, where a woman had a drilled trepanation on her mastoid process (which is situated behind the ear) (Brothwell 1974). The trepanation may have been employed in order to relieve a middle ear infection (Brothwell 1974: 210; or alternatively see Martin 2000; Roberts and McKinley 2001). There was no evidence of healing or infection, which indicates that the individual did not live long after the operation (Brothwell 1974: 209–10; c.f. Roberts 1997: 132; Rösing and Nerlich 2000). This discovery is important, as it demonstrates the use of Roman medical equipment in Britain, as earlier British examples were made using a scraping technique – a safer method (Larsen 1999: 153; see Verano 2000), which was found on the other example of a trepanation from the Roman period in York (Warwick 1968; Roberts and McKinley 2001). The use of Roman medical equipment suggests that this may have been undertaken by a doctor in the military fort (see Baker 2001; Jackson 2000).

### *Infant health and its relationship to female health status*

Infant health is an important aspect of palaeopathological study as it can be used as a gauge for the health status of the community (Saunders and Barrans 1999: 184; Goodman and Armelagos 1989: 239). The role of maternal health in infant survival is well documented within medical literature ([www.vh.org](http://www.vh.org)). Schell's work on stress in urban centres (1997) is important in demonstrating these links, especially during the uterine period and where the mother may have been a recent migrant to the area. Schell concludes that the urban environment can create stressors against which culture cannot buffer, as it poses a challenge to survival (i.e. toxic accumulations of materials) and dictates who is exposed to the infectious agents (1997: 67–8). Parents who were living in unsanitary conditions and were exposed to unhygienic materials (i.e. by-products of fulling – the production of cloth and felt, which used urine during manufacture) would subject the infant to a high risk of peri-natal death (Saunders and Barrans 1999: 197).

A large proportion of the infant remains in Table 9 did not display any osseous change. This may have been because they were incompatible with life due to soft tissue defects (see Barnes 1994: 5). However, it is proposed that many may have died from the effects of acute diarrhoea. Today, this remains the main killer for small children in developing countries, accounting for thirty percent of infant deaths (Mata 1983: 15), and was the main cause of death for children under ten in antiquity (Holman 1998: 1).

Table 9: Infants without an osseous response

Cemetery	Data
London	19/36 (76%)
Ilchester	5/6 (83%)
Chichester	1/1 (100%)
Colchester	33/36 (92%)
Poundbury Camp	1/50 (2%)
Cirencester	19/30 (90%)
York	18/18 (100%)

Just as likely in rural as in urban locations, it is prevalent where sanitation and personal hygiene are low, where infants are exposed to contaminated water, to internal parasites and food sources carrying salmonella (Mata 1983: 4–6; Bradley-Sack 1983: 60), and where breast-feeding is not regularly practiced (Saunders and Hoppa 1993: 135), as breast-feeding reduces the risks of contamination from other food sources (Rao and Rajpathak 1992: 1536). Its quality will not be reduced even if the mother has a low health status (Gopalan and Puri 1992: 1080). The risks and agents of morbidity are out of control of the infant, despite having serious consequences for its chances of survival, especially if the mother had succumbed to an infection during pregnancy which could be passed to the foetus, or passed on later during breast-feeding, thereby dramatically reducing the infant's chances of survival (Hall and Peckham 1997: 17).

If we accept that some women with iron deficiency in the sample were new mothers, important implications for infant care can be made. If a mother is anaemic, she will have lower activity levels, attention span and motivation, which will impact upon the level of care given to the infant (Ryan 1997: 50).

## Conclusions

The analysis of stress indicators, metabolic and infectious disease, in conjunction with a biocultural approach, strongly suggests that the effects seen on the individuals who were buried in urban cemeteries *may* reflect the urban environment in which they lived. However, until the results have been fully compared with those from rural cemeteries, urbanism itself cannot be proved to be the cause of such stress and disease.

The research has highlighted the differences between male and female health, especially with regards to metabolic and infectious disease and trauma. The focus upon female palaeopathology permits a greater understanding of subadult health, as well as providing links between osteological data and research into medical treatment and its access. The use of a biocultural approach has shown that the interpretation of palaeopathological data cannot be fully undertaken unless all facets of a culture are taken into account and combined to create an integrated and multifaceted analysis of past peoples. Therefore, a true understanding of Roman

Britain cannot be obtained unless the health of the people who helped to create it is integrated into the overall analysis of their archaeological record.

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### *Bibliography*

#### *Ancient sources*

Vitruvius Pollio. (translated by M. H. Morgan 1960). *Vitruvius: the ten books on architecture*. New York: Dover Publications.

#### *Modern sources*

- Ackerknecht, E. H. 1977. Primitive Surgery. In M. H. Logan and E. E. Hunt (eds.) *Health and the Human Condition. Perspectives on Medical Anthropology*. Massachusetts: Duxbury Press. 164–180.
- Adkins, L. and Adkins, R. A. 1998. *Handbook to Life in Ancient Rome*. New York: Oxford University Press.
- Allason-Jones, L. 1989. *Women in Roman Britain*. London: British Museum Press.
- Allason-Jones, L. 2001 unpublished. *Urban Angst in Roman Britain*. Paper presented at 'Roman Working Lives and Urbanization'. Conference held by the Research Centre for Roman Provincial Archaeology at the Department of Archaeology, The University of Durham. 14<sup>th</sup> July 2001.
- Armstrong, G. J., Goodman, A., and Jacobs, K. H. 1977. The ecological perspective in disease. In M. H. Logan and E. E. Hunt (eds.) *Health and the Human Condition. Perspectives on Medical Anthropology*. Massachusetts: Duxbury Press. 71–88.
- Apley, A. G. and Solomon, L. 2000. *Concise Systems of Orthopaedics and Fractures*. Second Edition. London: Arnold.
- Aufderheide, A. C. and Rodríguez-Martín, C. 1998. *The Cambridge Encyclopedia of Human Paleopathology*. Cambridge: Cambridge University Press.
- Baker, B. 1999. Early manifestations of tuberculosis in the skeleton. In G. Pálfi, O. Dutour, J. Deak, and I. Hutás (eds.) *Tuberculosis Past and Present*. Budapest: Golden Book Publisher Ltd. 301–307.
- Baker, P. A. 2001. Medicine, Culture and Military Identity. In G. Davies, A. Gardner and K. Lockyear (eds.) *TRAC 2000. Proceedings of the Tenth Annual Theoretical Roman Archaeology Conference London 2000*. Oxford: Oxbow Books. 48–68.
- Baker, P. A. and Carr, G. (eds.) 2002. *Practitioners, Practices and Patients: New approaches to Medical Archaeology and Anthropology*. Oxford: Oxbow Books.

- Barnes, E. 1994. *Developmental Defects of the Axial Skeleton in Paleopathology*. Colorado: University Press of Colorado.
- Bédoyère, de la, G. 1992. *English Heritage Book of Roman Towns in Britain*. London: B. T. Batsford Ltd.
- Bentley, D. and Pritchard, F. 1982. The Roman Cemetery at St Bartholomew's Hospital. *Transactions of the London and Middlesex Archaeological Society*, 33: 134–182.
- Birley, A. 1995. *The People of Roman Britain*. London: B. T. Batsford Ltd.
- Bogin, B. 1999 (second edition). *Patterns of Human Growth*. Cambridge Studies in Biological and Evolutionary Anthropology 23. Cambridge: Cambridge University Press.
- Bradley-Sack, R. 1983. Bacterial and Parasitic Agents of Acute Diarrhea. In J. A. Bellanti, (ed.) *Acute Diarrhea. Its Nutritional Consequences in Children. Nestlé Nutrition Workshop Series Volume 2*. New York: Raven Press. 53–65.
- Brickley, M. 2000. The diagnosis of metabolic disease in archaeological bone. In M. Cox and S. Mays (eds.) *Human Osteology in Archaeology and Forensic Science*. London: Greenwich Medical Media Ltd. 183–198.
- Brosch, R., Gordon, S. V., Marmiesse, M., Brodin, P., Buchrieser, C., Eiglmeier, K., Garnier, T., Gutierrez, C., Hewinson, G., Kremer, K., Parsons, L. M., Pym, A. S., Samper, S., van Soolingen, D. and Cole, S. 2002. A new evolutionary scenario for the Mycobacterium tuberculosis complex. *Proceedings of the National Academy of Sciences, USA*, 99(6): 3684–3689.
- Brothwell, D. R. 1974. Osteological Evidence of the Use of a Surgical Modiolus in a Romano-British Population: An Aspect of Primitive Technology. *Journal of Archaeological Science*, 1: 209–211.
- Brothwell, D. R. 1994. On the possibility of urban-rural contrasts in human population palaeobiology. In A. R. Hall, and H. K. Kenward (eds.) *Urban-rural connexions: perspectives from environmental archaeology. Symposia of the Association for Environmental Archaeology No. 12*. Oxford: Oxbow Books. 129–136.
- Buikstra, J. E. and Ubelaker, D. H. (eds.) 1994. Standards for Data Collection from Human Skeletal Remains. *Proceedings of a Seminar at The Field Museum of Natural History Organized by Jonathan Haas*. Arkansas: Arkansas Archaeological Survey Research Series No. 44.
- Bush, H. and Zvelebil, M. (eds.) 1991. Health in Past Societies: biocultural interpretations of human skeletal remains in archaeological contexts. Oxford: *British Archaeological Reports International Series*, 567.
- Bush, H. 1991. Concepts of Health and Stress. In H. Bush and M. Zvelebil (eds.) *Health in Past Societies: biocultural interpretations of human skeletal remains in archaeological contexts*. Oxford: British Archaeological Reports International Series, 567. 11–21.
- Clark, G. A., Hall, N. R., Armelagos, G. J., Borkan, G. A., Panjabi, M. M., and Wetzel, F. T. 1986. Poor Growth Prior to Early Childhood: Decreased Health and Life-Span in the Adult. *American Journal of Physical Anthropology*, 70: 145–160.
- Davies, R. W. 1971. The Roman Military Diet. *Britannia*, 2: 122–142.
- Davison, C. 2000. Gender Imbalance in Romano-British Cemetery Populations. In J. Pearce, M. Millett, & M. Struck (eds.) *Burial, Society and Context in the Roman World*. Oxford: Oxbow Books. 231–237.
- Dobney, K, Hall, A. and Kenward, H. 1999. Its all garbage ... A review of bioarchaeology in four English colonia towns. In H. Hurst (ed.) *The Coloniae of Roman Britain: New Studies and a review. Papers of the Conference held at Gloucester on 5–6 July, 1997. Journal of Roman Archaeology Supplementary Series. No. 36*. Portsmouth: Oxbow Books. 15–31.
- Ehrlich, P. R., Ehrlich, A. H. and Holden, J. P. 1973. *Human Ecology. Problems and Solutions*. United States of America: W.H. Freeman and Company.
- Eisenberg, L. 1991. Interpreting measures of community health during the Late Prehistoric period in Middle Tennessee: a biocultural approach. In H. Bush and M. Zvelebil (eds.) *Health in Past Societies: biocultural interpretations of human skeletal remains in archaeological contexts*. Oxford: British Archaeological Reports International Series, 567. 115–128.
- Esmonde Cleary, S. 1992. Town and country in Roman Britain? In S. Bassett (ed.) *Death in Towns: urban responses to the dying and the dead, 100–1600*. Leicester: Leicester University Press. 28–41.
- Evans, J. and O'Connor, T. 1999. *Environmental Archaeology Principles and Methods*. Stroud: Sutton Publishing Limited.

- Everton, R. F. and Rogers, J. 1982. The Human Remains. In P. Leach (ed.) *Ilchester Volume 1. Excavations 1974–1975*. Bristol: Western Archaeological Trust Excavation Monograph No. 3. 263–265.
- Farwell, D. E. and Molleson, T. L. 1993. *Excavations at Poundbury. 1966–80 Volume II: The Cemeteries*. Dorchester: Dorset Natural History and Archaeological Society Monograph Series Number 11.
- Fleming, R. 2000. *Medicine and the Making of Roman Women. Gender, Nature and Authority from Celsus to Galen*. Oxford: Oxford University Press.
- Freeth, C. 2000. Dental Health in British antiquity. In M. Cox and S. Mays (eds.) *Human Osteology in Archaeology and Forensic Science*. London: Greenwich Medical Media. 227–237.
- Foden, R. D. 1993. A Report on the Human Skeletal Remains. A. Down and J. Maglilton (eds.) *Chichester Excavations VIII*. Chichester: Chichester District Council. 89–94.
- Gopalan, S and Puri, R. K. 1992. Breast Feeding and Infant Growth. *Indian Pediatrics*, 29: 1079–1086.
- Goodman, A. H., Allen, L. H., Hernandez, G. P., Amador, A., Arriola, L. V., Chávez, A. and Pelto, G. H. 1987. Prevalence and Age at Development of Enamel Hypoplasias in Mexican Children. *American Journal of Physical Anthropology*, 72: 7–19.
- Goodman, A. H. and Armelagos, G. J. 1989. Infant and childhood morbidity and mortality risks in archaeological populations. *World Archaeology*, 21(2): 225–243.
- Goodman, A. H. and Rose, J. C. 1991. Dental Enamel Hypoplasias as Indicators of Nutritional Status. In M. C. Kelley and C. S. Larsen (eds.) *Advances in Dental Anthropology*. New York: Wiley-Liss. 279–293.
- Goodman, A. H. 1993. On the Interpretation of Health From Skeletal Remains. *Current Anthropology*, 34(3): 281–288.
- Goodman, A. H. and Song, R.-J. 1999. Sources of variation in estimate ages at formation of linear enamel hypoplasias. In R. D. Hoppa and C. M. Fitzgerald (ed.) *Human growth in the past: studies from bones and teeth*. Cambridge: Cambridge University Press. 210–240.
- Hall, A. J. and Peckham, C. S. 1997. Infections in childhood and pregnancy as a cause of adult disease – methods and examples. *British Medical Bulletin*, 53(1): 10–23.
- Hall, A. R. and Kenward, H. K. 1995. *Environmental Evidence from the Colonia*. The Archaeology of York. The Environment 14/6. York: Council for British Archaeology.
- Harrison, G. A. 1980. Urbanization and Stress. In E. J. Clegg and J. P. Garlick (eds.) *Disease and Urbanization. Volume XX. Symposia of the Society for the Study of Human Biology*. London: Taylor and Francis Ltd. 55–72.
- Holman, S. R. 1998. Infant feeding in Roman antiquity: prescription and risk. *Nutrition Today*. [http://www.findarticles.com/cf\\_0/m0841/n3\\_v33/21181283/print.jhtml](http://www.findarticles.com/cf_0/m0841/n3_v33/21181283/print.jhtml)
- Huber, B. R. and Anderson, R. 1996. Bonesetters and Curers in a Mexican Community: Conceptual Models, Status, and Gender. *Medical Anthropology*, 17: 23–38.
- Hughes, C. C. 1977. Medical Care: ethnomedicine. In M. H. Logan and E. E. Hunt (eds.), *Health and the Human Condition. Perspectives on Medical Anthropology*. Massachusetts: Duxbury Press. 150–158.
- Humphrey, L. T. 1998. Growth Patterns in the Modern Human Skeleton. *American Journal of Physical Anthropology*, 105: 57–72.
- Jackson, R. 2000. *Doctors and Disease in the Roman Empire*. London: British Museum Press.
- James, S. 2001. Soldiers and civilians: identity and interaction in Roman Britain. In S. James and M. Millett (eds.) *Britons and Romans: advancing an archaeological agenda*. CBA Research Report 125. York: Council for British Archaeology. 77–89.
- Jantz, R. L. and Owsley, D. W. 1984. Long bone growth variation among Arikara skeletal populations. *American Journal of Physical Anthropology*, 63: 13–20.
- Jenkins, A. V. C. 1997. Human Remains. In R. J. C., Smith, F., Healy, M. J., Allen, E. L., Morris, I. Barnes, and P. J. Woodward, (eds.) *Excavations Along the Route of the Dorchester By-pass, Dorset, 1986–8*. Wessex Archaeology Report No. 11. Dorchester: Henry Ling. 254–255.
- Jones, D. M. 1980. *Excavations at Billingsgate Buildings 'Triangle', Lower Thames Street, 1974*. <http://www.lamas.org.uk/abstracts/jones1980.html>
- Jones, R. F. J. 1993. Parasitological Investigations. In D. E. Farwell and T. L. Molleson. *Excavations at Poundbury 1966–80, Volume II: The Cemeteries*. Dorchester: Dorset Natural History and Archaeological Society Monograph Series Number 11. 197–8.

- Judd, M. A. 2000. *Trauma and Interpersonal Violence in Ancient Nubia during the Kerma Period (ca. 2500–1500 BC)*. University of Alberta: Canada. PhD Dissertation.
- Jurmain, R. 1999. *Stories from the Skeleton. Behavioral Reconstruction in Human Osteology*. New York: Gordon and Breach Publishers.
- Keily, F. 1988. *Skeleton Report. 13 Haydon Street*. Unpublished: Museum of London Archaeology Service.
- Kelley, M. A. and Micozzi, M. S. 1984. Rib lesions in chronic pulmonary tuberculosis. *American Journal of Physical Anthropology*, 65: 381–386.
- Kenward, H., Hall, A. R. and Jones, A. K. G. 1986. *Environmental Evidence from a Roman Well and Anglian Pits in the Legionary Fortress*. The Archaeology of York. The Past Environment of York 14/5. York, Council for British Archaeology.
- Kenward, H. and Hall, A. 1997. Enhancing bioarchaeological interpretation using indicator groups: stable manure as a paradigm. *Journal of Archaeological Science*. 24: 663–673.
- Kenward, H. 1999. Pubic Lice (*Phthirus pubis* L.) were present in Roman and Medieval Britain. *Antiquity*, 73: 911–15.
- Knight, R. 1982. *Parasitic Disease in Man*. Edinburgh: Churchill Livingstone Medical Texts.
- Kuijper, W. J. and Turner, H. 1992. Diet of a Roman centurion at Alphen aan den Rijn, The Netherlands, in the first century AD. *Review of Palaeobotany and Palynology*, 73: 187–204.
- Lagier, R. 1999. Paleopathological diagnosis of skeletal tuberculosis. In G. Pálfi, O. Dutour, J. Deak, and I. Hutás (eds.) *Tuberculosis Past and Present*. Budapest: Golden Book Publisher Ltd. 285–290.
- Larsen, C. S. 1999. *Bioarchaeology. Interpreting behaviour from the human skeleton*. Cambridge: Cambridge University Press.
- Leatherman, T. L. 1992. Illness as Lifestyle Change. In R. Huss-Ashmore, J. Schall and M. Hediger (eds.) *Health and Lifestyle Change*. Philadelphia: *MASCA Research Papers in Science and Archaeology*, 9:13–22.
- Lee, F. date unknown, unpublished. *The Human Skeletal Assemblage from Hooper Street, London*. Unpublished Report: Museum of London Archaeological Service Archive.
- Lukacs, J. R., Nelson, G. C. and Walimbe, S. R. 2001. Enamel Hypoplasia and Childhood Stress in Prehistory: New Data from India and Southwest Asia. *Journal of Archaeological Science*, 28: 1159–1169.
- Lovell, N. C. 1997. Trauma Analysis in Paleopathology. *Yearbook of Physical Anthropology*, 40: 139–170.
- Lovell, N. C. 2000. Paleopathological Description and Diagnosis. In M. A. Katzenberg and S. R. Saunders (eds.) *Biological Anthropology of the Human Skeleton*. New York: Wiley-Liss Inc. 217–248.
- Martin, G. 2000 unpublished. Why trepan? Answers from history and anthropology. In *International Colloquium on Cranial Trepanation in Human History, University of Birmingham 7<sup>th</sup>–9<sup>th</sup> April 2000*.
- Mata, L. 1983. An Overview. In J. A. Bellanti (ed.) *Acute Diarrhea. Its Nutritional Consequences in Children*. Nestlé Nutrition Workshop Series Volume 2. New York: Raven Press. 3–22.
- Manchester, K. 1992. The palaeopathology of urban infections. In S. Bassett (ed.) *Death in Towns: urban responses to the dying and the dead, 100–1600*. Leicester: Leicester University Press. 8–14.
- Mays, S. and Taylor, G. M. (forthcoming). A first prehistoric case of tuberculosis from Britain.
- McElroy, A. and Townsend, P. K. 1996. *Medical Anthropology in Ecological Perspective*. Boulder Colorado: Westview Press.
- McGrath, J. W. 1992. Behavioral Change and the Evolution of Human Host-Pathogen Systems. In R. Huss-Ashmore, J. Schall, and M. Hediger (eds.) *Health and Lifestyle Change*. Philadelphia: *MASCA Research Papers in Science and Archaeology*, 9:13–22.
- McKinley, J. 1999a. Human Bone from Tolpuddle Ball. In C. M. Hearne and V. Birbeck (eds.) *A35 Tolpuddle to Puddletown Bypass DBFO, Dorset, 1996–8*. Trowbridge: Trust for Wessex Archaeology. 150–172.
- McKinley, J. 1999b. *A35 Tolpuddle Ball Cemetery (W2405.17) Human Bone Archive Report*. Unpublished: Dorchester County Museum.
- McKinley, J. 2000. The Analysis of Cremated Bone. In M. Cox and S. Mays (eds.) *Human Osteology in Archaeology and Forensic Science*. London: Greenwich Medical Media Ltd. 403–421.

- Merbs, C. F. 1983. Patterns of Activity-Induced Pathology in a Canadian Inuit Population. *Archaeological Survey of Canada Paper No. 119*. Ottawa: National Museums of Canada.
- Merbs, C. F. 1989. Trauma. In M. Y. Isçan and K. A. R. Kennedy (eds.) *Reconstruction of Life from the Skeleton*. New York: Alan R. Liss. 161–189.
- O'Connor, T. P. 1988. *Bones from the General Accident Site, Tanner Row*. The Archaeology of York. The Animal Bones. York Archaeological Trust 15/2. York: Council for British Archaeology.
- Ortner, D. J. and Putschar, W. G. J. 1985. *Identification of Pathological Conditions in Human Skeletal Remains*. Smithsonian Contributions to Anthropology. Number 28. Washington D.C.: Smithsonian Institution Press.
- Ortner, D. J. 1992. Skeletal Pathology. Probabilities, Possibilities and Impossibilities. In J. W. Verano and D. H. Ubelaker (eds.) *Disease and Demography in the Americas*. Washington DC: Smithsonian Institution Press. 5–13.
- Ortner, D. J., Tuross, N. and Stix, A. I. 1992. New Approaches to the Study of Disease in Archaeological New World Populations. *Human Biology*, 64.3: 337–360.
- Ortner, D. J. 1998. Male-female immune reactivity and its implications for interpreting evidence in human skeletal paleopathology. In A. L. Grauer and P. Stuart-Macadam (eds.) *Sex and Gender in Paleopathological Perspective*. Cambridge: Cambridge University Press. 79–92.
- Ortner, D. J. 1999. Paleopathology: Implications for the history and evolution of tuberculosis. In G. M. Pálfi, O. Dutour, J. Deák and I. Hutás (eds.) *Tuberculosis Past and Present*. Budapest: Golden Book Publisher Ltd. 255–261.
- Overfield, T. 1995. *Biologic Variation in Health and Illness. Race, Age, and Sex Differences. Second Edition*. New York: C.R.C. Press.
- Palkovich, A. M. 1987. Endemic Disease Patterns in Paleopathology: Porotic Hyperstosis. *American Journal of Physical Anthropology*, 74: 527–537.
- Perring, D. and Brigham, T. 2000. Londinium and its Hinterland: The Roman Period. In M. Kendall (ed.) *The archaeology of Greater London. An assessment of archaeological evidence for human presence in the area now covered by Greater London*. Suffolk: MoLAS Monograph, Museum of London. 120–170.
- Pinter-Bellows, S. 1995. The Human Bone. In N. Crummy, P. Crummy and C. Crossans (eds.) *Colchester Archaeological Report 9: Excavations of Roman and later cemeteries, churches and monastic sites in Colchester, 1971–88*. Colchester: Colchester Archaeological Trust Ltd. 61–92.
- Polunin, I. 1977. The Body as Indicator of Disease. In Blacking, J. (ed.), *The Anthropology of the Body*. London: Academic Press. 85–98.
- Ramm, H. G. 1957. Roman Burials from Castle Yard, York. *Yorkshire Archaeological Journal*, 39: 400–413.
- Rao, S. and Rajpathak, V. 1992. Breastfeeding and Weaning Practices in Relation to Nutritional Status of Infant. *Indian Pediatrics*, 29: 1533–1539.
- Redfern, R. C. 2002 unpublished. *A re-evaluation of the Poundbury Camp human remains: a palaeopathological analysis*. Personal notes and data from PhD thesis 'A biocultural analysis of health in Dorset from the Iron Age to the post-Roman period'. University of Birmingham.
- Resnick, G. A. and Niwayama, G. 1988. *Diagnosis of Bone and Joint Disorders. 3<sup>rd</sup> Edition*. London: W. B. Saunders.
- Rheinhard, K. J. 1992. Parasitology as an interpretative tool in archaeology. *American Antiquity*, 57.2: 231–245.
- Richards, M. P., Hedges, R. E. M., Molleson, T. L. and Vogel, J. C. 1998. Stable Isotope Analysis Reveals Variations in Human Diet at the Poundbury Camp Cemetery Site. *Journal of Archaeological Science*, 25: 1427–1525.
- Roberts, C. 1991. Trauma and treatment in the British Isles in the historic period: a design for a multidisciplinary research. In D. J. Ortner and A. C. Aufderheide (eds.) *Human Paleopathology: Current Syntheses and Future Options*. Washington: Smithsonian Institution Press. 225–40.
- Roberts, C. 1997. Forensic anthropology 2: Positive identification of the individual; cause and manner of death. In J. R. Hunter, C. Roberts, and A. Martin (ed.) *Studies in Crime: An Introduction to Forensic Archaeology*. London: Routledge. 122–138.
- Roberts, C. A., Boylston, A., Buckley, L., Chamberlain, A. C. and Murphy, E. M. 1998. Rib lesions and tuberculosis: the palaeopathological evidence. *Tubercle and Lung Disease*, 79(1): 55–60.

- Roberts, C. A. and Manchester, K. 1999. *The Archaeology of Disease. Second Edition*. Ithaca: Cornell University Press.
- Roberts, C. A. 2000. Did they take sugar? The use of skeletal evidence in the study of disability in past populations. In Hubert, J. (ed.), *Madness, Disability and Social Exclusion. The archaeology and anthropology of 'difference'*. London: Routledge. 46–59.
- Roberts, C. A. and McKinley, J. 2001 unpublished. *Review of trepanations in British antiquity focusing on funerary context to explain their occurrence*.
- Robledo, B., Trancho, G. J. and Brothwell, D. 1995. Cribra Orbitalia: Health Indicator in the Late Roman Population of Cannington (Somerset, Great Britain). *Journal of Paleopathology*, 7(3): 185–193.
- Rogers, J. 1997. Human Remains. In R. J. C., Smith, F., Healy, M. J., Allen, E. L., Morris, I. Barnes, and P. J. Woodward, (eds.) *Excavations Along the Route of the Dorchester By-pass, Dorset, 1986–8*. Wessex Archaeology Report No. 11. Dorchester: Henry Ling. 154–157.
- Rothschild, B. and Rothschild, C. 1999. Evolution of osseous/radiologic signs of tuberculosis. In G. M. Pálfi, O. Dutour, J. Deák and I. Hutás (eds.) *Tuberculosis Past and Present*. Budapest: Golden Book Publisher Ltd. 293–298.
- Rösing, F. and Nerlich, A. 2000 unpublished. The pathology of trepanation: indications, healing and dry bone appearance in modern cases. In *International Colloquium on Cranial Trepanation in Human History, University of Birmingham 7<sup>th</sup>–9<sup>th</sup> April 2000*.
- Rowsome, P. 2000. *Heart of the City: Roman, medieval and modern London revealed by archaeology at 1 Poultry*. London: English Heritage, Museum of London Archaeology Service.
- Ryan, A. S. 1997. Iron-Deficiency Anemia in Infant Development: Implications for Growth, Cognitive Development, Resistance to Infection, and Iron Supplementation. *Yearbook of Physical Anthropology*, 40: 25–62.
- Salway, P. 1985. Geography and the growth of towns, with special reference to Britain. In F. Grew and B. Hobley (eds.) *Roman urban topography in Britain and the western Empire. Proceedings of the third conference on urban archaeology organized jointly by the CBA and the Department of Urban Archaeology of the Museum of London*. Research Report 59. The Council for British Archaeology. 67–73.
- Santos, A. L. 1999. TB Files: new hospital data (1910–1936) on the Coimbra Identified Skeletal Collection. In G. M. Pálfi, O. Dutour, J. Deák and I. Hutás (eds.) *Tuberculosis Past and Present*. Budapest: Golden Book Publisher Ltd. 127–134.
- Sargent, C. F. and Johnson, T. (eds.) 1996. *Medical anthropology. Contemporary theory and method*. London: Praeger.
- Saunders, S. R. and Barrans, L. 1999. What can be done about the infant category in skeletal samples? In R. D. Hoppa and C. M. Fitzgerald (eds.) *Human growth in the past: studies from bones and teeth*. Cambridge: Cambridge University Press. 183–209.
- Saunders, S. R. and Hoppa, R. D. 1993. Growth Deficit in Survivors and Non-Survivors: Biological Mortality Bias in Subadult Skeletal Samples. *Yearbook of Physical Anthropology*, 36: 127–151.
- Schell, L. M. 1997. Culture as a Stressor: A Revised Model of Biocultural Interaction. *American Journal of Physical Anthropology*, 102: 67–77.
- Scheuer, L. and Black, S. 2000. *Developmental Juvenile Osteology*. London: Academic Press.
- Scobie, A. 1986. Slums, Sanitation, and Mortality in the Roman World. *Klio*, 68(2): 399–433.
- Selye, H. 1957. *The Stress of Life*. London: Longmans Green and Co.
- Stinson, S. 1985. Sex Differences in Environmental Sensitivity During Growth and Development. *Yearbook of Physical Anthropology*, 28: 123–147.
- Storey, R. 1992. Preindustrial Urban Lifestyle and Health. In R. Huss-Ashmore, J. Schall and M. Hediger (eds.) *Health and Lifestyle Change*. Philadelphia: *MASCA Research Papers in Science and Archaeology*, 9: 33–42.
- Stuart-Macadam, P. 1991. Anemia in Roman Britain: Poundbury Camp. In H. Bush and M. Zvelebil (eds.) *Health in Past Societies: biocultural interpretations of human skeletal remains in archaeological contexts*. Oxford: British Archaeological Reports International Series, 567: 101–113.
- Stuart-Macadam, P. 1992. Anemia in Past Human Populations. In P. Stuart-Macadam and S. Kent (eds.) *Diet, Demography, and Disease. Changing Perspective on Anemia*. New York: Aldine de Gruyter. 151–170.



- Verano, J. W. 2000 unpublished. Trepanation in prehistoric South America: geographic and temporal trends over 2000 years. In *International Colloquium on Cranial Trepanation in Human History*, University of Birmingham 7<sup>th</sup>–9<sup>th</sup> April 2000.
- Vincent, V. and Perez, G. M. C. 1999. The agent of tuberculosis. In G. M. Pálfi, O. Dutour, J. Deák and I. Hutás (eds.) *Tuberculosis Past and Present*. Budapest: Golden Book Publisher Ltd. 139–143.
- Waldron, T. 1983. *The Human Bones from 9 St Clare Street*. Unpublished: Museum of London Archaeological Service.
- Waldron, T. 1984. *The Human Bones from West Tenter Street. Part 1: The Inhumations*. Unpublished: Museum of London Archaeological Service.
- Waldron, T. 1985. *The Three Lords. Human Bone Report*. Unpublished: Museum of London Archaeological Service.
- Waldron, T. 1989. The effects of urbanism on human health: the evidence from skeletal remains. In D. Serjeanston and T. Waldron (eds.) *Diet and Crafts in Towns. The evidence of animal remains from the Roman to the Post-Medieval periods*. Oxford: British Archaeological Reports British Series, 199: 55–73.
- Waldron, T. 1994. *Counting the Dead. The Epidemiology of Skeletal Populations*. Chichester: Wiley-Liss.
- Walker, P. L. 1997. Wife Beating, Boxing, and Broken Noses: Skeletal Evidence for the Cultural Patterning of Violence. In D. L. Martin and D. W. Frayer (eds.) *Troubled Times. Violence and Warfare in the Past. War and Society Volume 3*. India: Gordon and Breach Publishers. 145–180.
- Warwick, R. A. 1968. Report on the Skeletal Remains. In L. P. Wenham (ed.) *The Romano-British Cemetery at Trentholme Drive, York*. London: Her Majesty's Stationary Office. Ministry of Public Buildings and Works Archaeological Reports. No 5. 129–145.
- Wells, C. 1982. The Human Burials. In A. McWhirr, L. Viner and C. Wells (eds.) *Cirencester Excavations II. Romano-British Cemeteries at Cirencester*. Cirencester: Cirencester Excavation Committee. 135–202.
- Weinberg, E. D. 1992. Iron Withholding in Prevention of Disease. In P. Stuart-Macadam and S. Kent (eds.) *Diet, Demography, and Disease. Changing Perspectives on Anemia*. New York: Aldine de Gruyter. 105–150.
- White, B. 2000. The Human Remains. In A. McKinder (ed.) *A Romano-British cemetery on Watling Street. Excavations at 165 Great Dover Street, Southwark, London*. London: Museum of London Archaeological Service. 33–49 and 63–4.
- Wood, J. W., Milner, G. R., Harpending, H. C. and Weiss, K. M. 1992. The osteological paradox: problems of inferring prehistoric health from skeletal samples. *Current Anthropology*, 33: 343–58.

#### Websites

<http://www.vh.org.com>

<http://www.vh.org/Patients/IHB/Peds/Safety/DrinkingWater/DrinkingWater.html>

<http://www.vh.org/Providers/ClinRef/FPHandbook/Chapter18/03–18.html>

#### Appendix of sites used in this study

**London** – St Bartholomew's Hospital (Bentley and Pritchard 1982), West Tenter Street (Waldron 1984), Watling Street (White 2000), Hooper Street (Lee date unknown), The Three Lords (Waldron 1985), St Clare's Street (Waldron 1983) and Haydon Street (Keily 1988).

**Dorchester** – Poundbury Camp (Farwell and Molleson 1993)

**York** – Castle Yard (Ramm 1957) and Trentholme Drive (Warwick 1968)

**Colchester** – Butt Road Site (Pinter-Bellows 1995)

**Chichester** – St Pancras Cemetery and Theological College (Foden 1993)

**Ilchester** – Little Spittle and Townsend Close (Everton and Rogers 1982), and

**Cirencester** – North and South of the Fosse Way (Wells 1982).