FRACTURES IN EIGHTEENTH-CENTURY LONDON

SLIPS, TRIPS, FALLS, AND BRAWLS: FRACTURES OF THE WORKING POOR IN LONDON DURING THE LONG EIGHTEENTH CENTURY

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ABSTRACT

This thesis contributes insight into the lives and injury experiences of the working poor of London, UK during the "long" eighteenth century. The distribution of fracture types within individual bodies and the larger experiences of those living and dying during this period are explored. Skeletal evidence, drawn from five London cemeteries, and historical evidence, in the form of contemporary hospital admission records and surgeons' and physicians' notebooks, speak in concert to reveal evidence of sex-based differences in fracture patterning and evidence for interpersonal violence.

Sex-based differences in fracture patterning reveal that males and females suffered differing constellations of fractures and that the risk of fracture for males and females differed throughout the life course. Patterning of fractures in the male skeletal sample suggests that males' lives were punctuated with episodes of interpersonal violence, supporting the historical data found in contemporary court records. Significant differences observed in the fracture frequencies in the skeletal and archival datasets indicate that not all fractures were being treated in a hospital setting. These results allow for examination of the intangible notion of human choice regarding health care in the past. The mixture of healed, healing, and perimortem fractures found in the skeletal sample allows for a relative timeline of fracture events to be reconstructed, contributing to a more comprehensive life course understanding of fractures in this group.

Ultimately, the combined skeletal and archival datasets contribute to anthropological and historical studies of fractures and health care by placing the working poor at the centre of their own narrative.

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LIST OF ALL ABBREVIATIONS AND SYMBOLS

MoL	Museum of London
RCS	Royal College of Surgeons Archive
KCL	King's College London Archive
LMA	London Metropolitan Archives
UCL	University College London Hospitals NHS Trust Archive
St. B	St. Bartholomew's Hospital Archive

DECLARATION OF ACADEMIC ACHIEVEMENT

I declare that the content of the research in this document has been completed by myself, Madeleine Mant, with recognition of the contributions of Dr. Megan Brickley, Dr. D. Ann Herring, and Dr. Juanita de Barros in both the research process and the completion of the thesis.

CHAPTER 1.0 – INTRODUCTION

1.1 INTRODUCTION

This research explores the lives and skeletal fractures experienced by the working poor of London during the "long" eighteenth century. The medical marketplace of London is an ideal context in which to examine the distribution of fracture types within individual bodies and the larger experience of individuals living and dying during this period of substantial change. This "long" eighteenth century contains the whole of the Georgian era, spanning the reigns of King George I, George II, George III, and George IV, from 1714 to 1830, and the reign of William IV (1830-1837).

I aim to elucidate the lives of the working poor using multiple lines of data. The first consists of the skeletal remains of individuals who lived and died during this period. The second is hospital admission and discharge records from the general hospitals of London. Historic demographic data provide a window into past human experience. Writing about vital phenomena, Tilly notes that demographic analysis "permits us to deal with the individual and the group at the same time: first by specifying the logic by which the one is aggregated into the other; second, by permitting us to compare the experience of any particular individual with that of the population to which the individual belongs" (1978, p. 10). Institutional records for a delimited population, such as the hospital admittance records under scrutiny, capture individuals who represent a specific subgroup of the population. Hospital admission records contain information on individuals who were likely to be of a similar social class, but did not necessarily live near one another or share other characteristics. Before the advent of the census in England in 1801, many individuals may have gone unrecorded in parish records, particularly if they were neither baptized nor visited a notary to record a marriage or create a will. Deyon refers to the "mute presence" of the geographically mobile urban poor of the eighteenth century as "the obscure among the obscure" and notes that these individuals are often "identifiable only in court or hospital registers" (1975, p. 51). Examining the time that individuals may have spent in an institution such as a hospital provides information on their own institutional "career" – here defined following Goffman (1961) as "any social strand of a person's course through life" (p. 127) – and gives a "richer understanding not only of institutional subgroups within historical populations but also of those populations themselves" (Willigan & Lynch, 1982, p. 153).

Skeletal and archaeological evidence complement documentary and historical evidence. Using multiple forms of evidence provides the best foundation for interpretation and this approach has been developed in several important volumes. *Human Biologists in the Archives* (Herring & Swedlund, 2003) explores how historical and archival evidence may be used to investigate physical anthropological questions concerning health, nutrition, and demography. *Grave Reflections* (Saunders & Herring, 1995) and *Bodies of Evidence* (Grauer, 1995) discuss the integration of skeletal evidence with death records, censuses, and material culture to investigate questions concerning past lifeways. Papers in *The Bioarchaeology of Individuals* (Stodder & Palkovich, 2012) demonstrate how the incorporation of skeletal, stable isotopic, and documentary evidence may illuminate individual lives. Historical evidence is not always available at the individual level; Cox (1995) notes that without the coffin plates providing biographical information for the Christ Church Spitalfields crypt skeletal sample, "different conclusions would have been deduced" (p. 21). Excavations at the ruins of St. James Episcopal Church in Virginia helped enrich and confirm limited historical records that burials were associated with the structure (Owsley et al., 1992).

Various studies emphasize the importance of studying marginalized groups in the past who may have been illiterate or unable to record their own histories, following the example set by Eric Wolf in 1982 in *Europe and the People Without History*. The biology of poverty has been investigated by a variety of researchers studying skeletal remains (e.g., Grauer & McNamara, 1995; Higgins & Sirianni, 1995; Phillips, 2001; Sirianni & Higgins, 1995; Steegmann, 1991; Wesolowsky, 1991). These studies have corroborated historical accounts that almshouse inmates lived in overcrowded and sometimes filthy conditions that encouraged the spread of infectious disease.

It is not possible to examine the hospital experience of every individual who entered a general hospital in London in the "long" eighteenth century. Following the example of Risse (1986), however, it is possible to use hospital admission registers to "reconstruct a partial profile of those persons who successfully applied for admission" (p. 87). These available data make it possible to construct an overview of the fracture experience of working class individuals in London. Historical studies of poverty have been criticized for being "rarely concerned with the poor as subjects of their own stories" (Rimstead, 2001, p. 23) and there is an increasing desire to bring attention to "the experiences of, responses to, and realities of their lives as individuals" (Levene, 2006, p.

xix) in the historical community. In this research I seek to place individuals of the working poor as central figures in their story by examining their skeletal remains for clues to their lived experience with health and injury.

This thesis contributes insight into the lives and injury experiences of the working poor of London during the "long" eighteenth century. Sex-based differences in fracture patterning reveal that males and females suffered differing constellations of fractures and that the risk of fracture for males and females differed throughout the life course. Patterning of fractures in the male skeletal sample suggests that males' lives were punctuated with episodes of interpersonal violence, supporting the historical data found in contemporary court records. Significant differences observed in the fracture frequencies in the skeletal and archival datasets indicate that not all fractures were being treated in a hospital setting. These results allow for examination of the intangible notion of human choice regarding health care in the past. The mixture of healed, healing, and perimortem fractures found in the skeletal sample allows for a relative timeline of fracture events to be reconstructed, contributing to a more comprehensive life course understanding of fractures in this group.

1.2 RESEARCH QUESTIONS

In this research I seek to gain insights into the lives and fracture experiences of the working poor in London through investigating the following questions:

a. What relationships exist between the skeletal and admissions datasets?

b. What are the sex-based differences, if any, in fracture frequency in both the skeletal and admission record datasets?
c. Does the fracture patterning in the skeletal dataset provide putative evidence for possible interpersonal violence?
d. What does the presence of perimortem trauma in the skeletal dataset reveal about fracture experience?
e. What is the average length of stay in hospital as determined from the hospital admissions records?
f. Are there individuals seeking multiple re-admissions to hospital in the admissions dataset?
g. What are the occupations of individuals admitted to hospital?

In addition, I highlight the benefits of incorporating multiple lines of evidence to investigate a historical question and address the challenges of this incorporation.

1.3 THESIS CHAPTERS

This thesis is organized into eight chapters. Following this introduction, Chapter 2 provides a historical introduction to the medical marketplace of London during the "long" eighteenth century. Contemporary understandings of fractures and their treatments are explored and the working poor are characterized and described. Chapter 3 is divided into two sections; the first describes the skeletal collections studied, the historical backgrounds of the cemetery sites, and the osteological methods employed in estimating the sex and age-at-death of the skeletal sample and the fracture recording methodology.

The second section describes the archival record holdings examined and includes an assessment of data quality and completeness. Chapters 4, 5, and 6 present and discuss the results of the data collection and analysis. Chapter 4 focuses on the overall evidence for fractures in the skeletal and archival datasets and compares the frequency of fractures between the datasets. Chapter 5 examines the sex- and age-based patterns discovered in the fracture data and provides clinical and historical context for the most frequently observed fractures. Chapter 6 outlines possible causes of the observed fractures, including interpersonal violence. Injury recidivism and the occupations of individuals who sought admission to the Royal London hospital are discussed. Chapter 7 outlines the challenges of incorporating multiple datasets and highlights the positive results from this research. The conclusion, Chapter 8, summarizes the overall findings of this research and includes suggestions of future directions for research based upon these findings.

CHAPTER 2.0 – HISTORICAL BACKGROUND AND CONTEXT

2.1 INTRODUCTION

This chapter outlines the historical context in which the research project is based. I discuss the "long" eighteenth century as a temporal period and outline contemporary medical practice and theory. The practitioners and participants in health – the physicians, surgeons, apothecaries, quacks, and patients – are discussed and the rise of general practice at the voluntary hospital is outlined. The concept of the medical marketplace is discussed. I examine the literature concerning patient experience of illness, particularly the diagnosis and treatment of fractures, during the "long" eighteenth century.

2.2 HISTORICAL BACKGROUND OF "LONG" EIGHTEENTH-CENTURY LONDON

Many scholars studying the era in question refer to it as the "long" eighteenth century, a period defined inconsistently in the literature. Individual researchers define the "long" century as bounded by different historic and cultural events, most starting roughly with the end of the plague years in England or the Revolution of 1688 and ranging through the 1700s to the Battle of Waterloo in 1815 or just before the advent of official government census in England and Wales in 1837. Culturally, the era is known as the Age of Enlightenment, a movement directed by intellectuals such as John Locke and Voltaire, who sought the advancement of reason over faith (Rusnock, 2002). Over the "long" eighteenth century, London contained approximately 10% of England's total population, with about 585,000 individuals at the end of the seventeenth century and nearly 1,000,000 by the end of the eighteenth, and its population grew at a rate consistent with the rest of the country (Landers, 1990, 1991; Razzell, 2007; Wrigley & Schofield, 1981).

England experienced a decline in mortality during the eighteenth century; historians and historical demographers have nominated a plethora of explanations for this decrease. Thomas McKeown asserts that improved nutrition and a rise in the standard of living explain the decreased mortality rates, which he concludes fell amongst the general population before the elite (1976; McKeown & Brown, 1955; McKeown & Record, 1962); his assertions have been re-evaluated and defended by Harris (2004). Szreter (1988) and Hardy (1993) extend this argument into an examination of mortality rates in nineteenth-century England, asserting that the public health reform movement was of primary importance in the overall mortality decline. Others, such as Razzell (1994, 2007), posit that infant mortality rates fell first among the elite, professional, and aristocratic families due to the complex interaction of environmental improvements. Further, Wrigley and Schofield (1981) point out that real wages grew by nearly 50% in England between 1600 and 1749. These data may indicate that nutritional standards may have been a lesser influence on mortality patterns than McKeown theorized, though their methods have been criticized by Hatcher (2003), who notes that "demographic events are rooted in the most vital and pervasive strands of human life…we should soon move beyond simple linear relationships…and encounter a kaleidoscopic [pattern] of cause and effect" (p. 128). A variety of sanitary and public health improvements have been nominated as contributing to the overall decline of mortality, including building houses of brick, stopping the use of dirt floors in houses, the introduction of house drainage, widespread vaccinations against smallpox, and better breastfeeding practices (Fildes, 1986; Guha, 1993; Haines & Shlomowitz, 1998; Mercer, 1985, 1990; Razzell, 1965, 1994; Razzell & Spence, 2007). Further, the passing of private improvement acts in London from the 1740s onwards likely played a large role in the falling mortality rates (Porter, 1991a; Wohl, 1983).

2.3 MEDICINE IN LONDON DURING THE "LONG" EIGHTEENTH CENTURY

The "long" eighteenth century has commonly been termed the "age of agony" in reference to the lack of anaesthetics (Porter, 1982; Williams, 1986). Until the advent of chloroform in the nineteenth century, alcohol and medically-prescribed opiates were popular pain killers (Porter & Porter, 1989). The lack of anaesthetics, however, is a too simplistic characterization of eighteenth-century medicine. Guy Williams published the popular history books *Age of Agony* (1986), concerning medicine in the eighteenth century, and *Age of Miracles* (1987), about medicine and surgery in the nineteenth century. These volumes create an artificial distinction between the eighteenth and nineteenth centuries, labeling the eighteenth as barbarous and the nineteenth as revolutionary. This falsely separates a temporal continuum and devalues the medical advances made during the eighteenth century, such as the advent of smallpox inoculation and the introduction of social scientific studies of population health (Fox et al., 1995; Hopkins, 1983; Razzell, 2003; Riley, 1987). Medicine in London during the "long" eighteenth century is better characterized and explored by examining not what was absent, but by what was present – large numbers of medical graduates competing for patients in a medical marketplace based on consumerism.

Until the mid-eighteenth century, Oxford and Cambridge were the primary centres of medical education; a smaller number of medical graduates came from Leiden and Trinity College, Dublin (McDowell & Webb, 1982; Poynter, 1966; Webster, 1986). The *Medical Register*, compiled in 1783, indicates that in London alone there were 968 registered surgeons, apothecaries, and physicians (Bynum, 1985) though this total does not include the many alternative medicinal practitioners such as quacks, bonesetters, and wise women. In 1783 the English provinces had the ratio of one medical practitioner to 2224 people; London boasted a ratio nearly three times better (Digby, 1994). Competition for patients increased as students began studying medicine at the various London hospitals such as Guy's, the Royal London, the Middlesex, the Royal Free, St. Bartholomew's, St. George's, St. Thomas', University College, and the Westminster Hospital (Digby, 1994). In the 1780s and 1790s there were between 100 and 150 pupils total studying at the hospital schools; by 1815 the number of enrolled pupils had reached 350 (Lawrence, 1985), and by 1841 the London medical schools alone had 951 enrolled students (Digby, 1994). By the beginning of the nineteenth century, English students began attending the Scottish universities – Aberdeen, Edinburgh, Glasgow, and St. Andrews – in greater numbers (Rosner, 1991) and by 1800 the University of Edinburgh was considered to be the most prestigious institution for medical education due to its combination of theory and practical instruction (Digby, 1994). Private schools operating out of anatomy schools and dispensaries in London were also training students in the late 1700s, though reliable figures of enrolment are not readily available (Cope, 1966).

During the seventeenth century women had served as surgeons and apothecaries, albeit in smaller numbers than men (Pelling & Webster, 1979), but during the "long" eighteenth century women primarily specialized in domestic healing and midwifery (Porter & Porter, 1989). There are fewer well-known female practitioners from the period; notable exceptions include Joanna Stephens, who sold her cure for dissolving bladder stones to the English Parliament for £5,000 (Ehrenreich & English, 1973). Though more recent attention has been focused on female healers and women's experiences with the medical system (e.g., Helmstadter, 2002; Siena, 2001; Smith, 2003) it is an area deserving of further scrutiny.

2.4 HUMOURS AND THE EIGHTEENTH-CENTURY BODY

Before the advent of germ theory, following the discoveries of Louis Pasteur and Robert Koch, and the splitting of physicians into contagionism and anti-contagionism camps, medical diagnosis and the prescription of medicines or *physic* depended upon the assessment of an individual's humours. The humoural theory drew upon the classical works of Hippocrates and Galen, who defined illness as the result of disturbance in the equilibrium between the body's four humours: blood, phlegm, yellow and black bile (Jewson, 1974; Philips, 1973; Siegel, 1968) which were said to influence both the health and temperament (Figure 2.1). These authors remained standard reading for medical students at English universities throughout the eighteenth century (Jewson, 1974). Bodies were viewed as envelopes or sacs of fluids (Rawcliffe, 1995) and illness was perceived to arise when humours became unbalanced; fluxions, the rising and falling of vapours, and stoppages were common symptoms of illness.

Figure 2.1 Representations of the four temperaments associated with humoural theory – choleric (yellow bile), sanguine (blood), phlegmatic (phlegm), and melancholic (black bile)

(Wellcome Library, London. Images from Iconologia, circa 1610, Cesare Ripa. Library reference no: Slides 4031, 4032, 4033, 4034. Copyrighted work available under Creative Commons Attribution only licence CC BY 4.0 http://creativecommons.org/licenses/by/4.0/ Individual images have not been altered, but have been placed into collage format.)

An advertisement placed in the proceedings of the Old Bailey, London's central court, in 1714 employs humoural theory to advertise the skills of a medical practitioner:

> "Whereas several Gentlewomen, and others of that Sex, in this Kingdom, have contracted an evil Habit of Body, wherein the vicious Humours at first dispers'd thro' the whole, come at length to be lodg'd in one part or another, and many times…are thrown down on the Womb, occasioning a dangerous Weakness in that part, which being neglected, at last turns Cancerous, and often proves fatal"
> (Old Bailey, 1714).

Aside from medicine, humours were also used to explain strong emotions such as jealousy, ambition, and pride (Hamlin, 1998).

The diagnosis of a patient during the "long" eighteenth century depended upon a symptomatic, or whole-person, approach that was based in empiricism rather than theory (Digby, 1994). The symptoms of illness were viewed as the illness itself; therefore, physicians focused primarily on the patient's experience rather than seeking the ultimate cause of illness (Kaba & Sooriakumaran, 2007). Medical practitioners employed humoural theory to understand the inner workings of the body, in addition to assessing "blood quality" and the movement of fluids within the body (Smith, 2008). According to contemporary medical thinking, illness could not exist independently of an individual's body (Pilloud & Louis-Courvoisier, 2003); the body was perceived as a "bounded, decontextualized unit" (Lock & Nguyen, 2010, p. 40). The humoural body interacted with the external environment through the Classic perception of the "six non-naturals" – diet, air, exercise, sleep, waste excretions, and passions of the soul (Emch-Dériaz, 1992). When illness occurred, treatment focused on bringing the bad or excess blood and juices to the exterior of the body through "phlebotomy, emesis, defecation, urination, blistering, or sweating" (Gronim, 2006, p. 255). Purging the body to yield products such as "smart vomit" (Porter & Porter, 1989, p. 160) encouraged patients to believe that the physician's medicine was working, at least by creating a visible effect (Wear, 1985). The individual's body and its interactions with the physical environment, for example, the weather, were viewed as unique; the job of the physician, therefore, was to tune the individual's body and constitution to elements such as the climate through diet and exercise (Hamlin, 1998). Dobson (1997, p. 14) provides an illuminating exploration of the geography and climate of England and the "olfactory map" of perceived good and bad air in London and its environs. Excessive heat or cold could cause an individual literally to "[feel] under the weather" (Dobson, 1997, p. 20).

A lack of understanding of micro-organisms and belief in holy intervention in matters of health allowed many infectious diseases to flourish. Indeed, English monarchs were still touching for the King's Evil (scrofula) until April 27, 1714 when Queen Anne completed the ritualistic monarch's touch for the final time (Bloch, 1972). Magical thinking played a role in lay medicine and understandings of the body (Richardson, 1987), such as the belief that what a pregnant woman saw would imprint upon her unborn foetus. One example noted in William Dyer's diary in 1759 states that a child was born with a mark on its lip because its mother was scared by seeing a cat carrying a rat in its mouth (qtd. in Barry, 1985). The role of religion was significant and many people believed that their "heavenly physician" (Wear, 1985, pp. 96-97) played an equal or greater role than the earthly physician in their progress as patients. A shocking sensation or strong stimulus may affect the passions (one of the six non-naturals), causing convulsions or fainting due to the perceived close connection between humours, body, and mind (Wild, 2000).

2.5 SPILLS, FALLS, AND BRAWLS: FRACTURES IN THE "LONG" EIGHTEENTH CENTURY

Despite operating under a humoural philosophy, medical practitioners during the "long" eighteenth century appear to have been able to identify and treat fractures successfully. Simple, or closed, fracture treatment was a routine procedure for contemporary surgeons. The mechanism of healing may not have been fully understood, but bone was understood to be a living structure following the work of Clopton Havers (1691) and John Belchier (1735). Bone growth was a topic of scholarly interest; Stephen Hales (1717) noted that bones grew in length due to growth at the epiphyses and John Hunter (1835) posited that during growth new bone was laid down and absorbed. Antonio Scarpa (1799) observed that bone formation at a fracture site is similar to growth occurring during normal skeletal growth and development. The mechanism of fracture healing was not completely understood; indeed, details of fracture healing are still being investigated in contemporary clinical studies (e.g., Einhorn & Lee, 2001; Ferguson et al., 1999; Xian & Foster, 2006; Yuasa et al., 2015), since the osteoblasts and osteoclasts, cells integral to bone growth and maintenance, and osteoid, the uncalcified matrix of bone, were not described in the medical literature until the mid-19th century (Goodsir, 1845; Kolliker, 1873; Virchow, 1853).

Physicians were tasked with taking clinical histories from patients to determine their diagnosis. The symptomatological approach to illness meant that the physician's interview with the patient – either through letters or in person – was a crucial step in diagnosis. A physical examination of the body was generally not viewed as necessary (Porter, 1993; Reiser, 1978; Smith, 2008). The physician expected a variety of details to be included as part of a patient's story or illness narrative, such as pains and other symptoms, eating and sleeping habits, bowel movements, and recent emotional events (Brody, 1987; Kleinman, 1988). Holism was encouraged, since the classic teachings favoured by eighteenth-century physicians emphasized the dualism of mind and body. If a physical examination did occur, it would primarily be limited to looking rather than touching; a patient's complexion and any lesions would be observed and their pulse might be taken (Bynum & Porter, 1993; Reiser, 1978). In the late-eighteenth and early-nineteenth centuries, the physical examination gained importance as the idea that disease could be localized in a certain organ became increasingly accepted (Armstrong, 1983). During the majority of the eighteenth century, however, the physician did not yet have privileged access to the patient's illness; it was the responsibility of the patient to articulate his or her troubles (Jewson, 1974; Porter, 1985a). Indeed, new mechanical aids for diagnosis such as the stethoscope (invented in 1816) and thermometer (early versions existed in the seventeenth century) took time to be accepted after the "long" eighteenth century since they necessitated close physical contact between patient and physician (Carpenter, 2010).

Various challenges faced the physician, such as communication problems due to language barriers, patients' intimidation due to the differing social stations between patients and physicians, or the exaggeration of symptoms (Risse, 1986). These challenges, when applied to patients suffering from a fracture, particularly a dramatic compound injury, prove less challenging than attempting to differentiate between various febrile diseases or determine the cause of vague aches and pains. The diagnosis of fractures depended upon the "patient's history of injury, pain and loss of function, physical findings of deformity, loss of normal motion, false motion, crepitus, visible bone fragments in a wound, swelling, and ecchymosis" (Peltier, 1990, p. 6). Similarly, the healing of a fracture was indicated by "a palpable nontender callus and the loss of false motion" (Peltier, 1990, p. 6).

Fractures were most commonly splinted by a surgeon and allowed time to heal on their own. Sir Benjamin Brodie, the celebrated nineteenth-century surgeon at St. George's, used the example of a fractured olecranon to illustrate the ease with which most fractures were treated, stating that "the bone should be retained in a proper situation by means of a bandage, and the arm kept extended by means of a splint, and no other treatment is required" (Brodie, RCS MS0162, 1805-07, n.p.). Surgeon William Pulsford recorded that in 1757, 91 of his 334 total cases were due to trauma. Of these 91, 18 were fractures and dislocations caused by accidents involving falling from or being kicked by horses, falling from trees or ladders, and interpersonal violence (Loudon, 1986, pp. 78-79). Simple, or closed, fractures do not seem to have been regarded with much alarm. Correspondence between the agent of a country estate and his master in London in 1727 notes the following incident:

> 8 May 1727: yesterday about 3 o'clock the poor nurse fell down in the stone court, it being wet and slippery, and broke both the bones of her arm about 3 inches above her right hand. I sent immediately for Mr Fryer, who came and set it before eight…
>
> 11 May 1727: the nurse is intirely [sic] free from pain (qtd. in Lane, 1985, pp. 208-209).

Treatment for simple or closed fractures involved the reduction of the fracture and splinting or bandaging the injury with either wooden splints or junks (straw wrapped tightly in cotton cloth) to reduce or prevent movement of the fractured bone. Theodoric, writing in the 13th century, aptly summarized the basic tenets of fracture treatment:

> And the first objective is the true and correct reduction or realignment of the broken or separated bones. The second is the maintenance of the afore-mentioned state by proper binding. The third objective is to restore the intervening flesh to its proper place (1855-1860 [1267], p. 160).

Grauer and Roberts's (1996) study of healed long bone fractures in medieval individuals concluded that medieval individuals in York, England must have practiced fracture immobilization. Indeed, the treatment for fractures changed little throughout the medieval and post-medieval periods before the advent of germ theory and the discovery of X-rays in 1895.

Percivall Pott, the leading surgeon in London following the death of William Cheselden, advocates in his book *Some Few General Remarks on Fractures and Dislocations* (1769), that a fractured limb should be placed in the position in which the muscles are in the greatest state of relaxation to reduce the displacement of fracture fragments. Admission records from the Westminster Hospital reveal a variety of strategies for dealing with individuals with fractures. Bandages, rest, application of cold compresses "to keep down the temperature of the leg" were prescribed, along with the application of heat, purges, bleedings, poultices, and sometimes amputation (Westminster Hospital, RCS MS0162, 1817-1818, n.p.). James Howard, a boy of 12 admitted on 31 May 1818 for a fractured humerus, was prescribed "nothing but quiet," until his discharge on 12 July 1818 (Westminster Hospital, RCS MS0162, 1817-1818, n.p.). The cost of fracture treatment was an important consideration; complicated fractures could prove expensive. Labourer Sarah Stacey suffered "an extremely bad compound fracture of the Os Humerus" (qtd. in Loudon, 1986, p. 84) after being run over by a carriage in 1774. Her employer footed the bill (£21. 9s. 2*d*), the equivalent of Sarah's annual wages, for a surgeon to treat her nearly every day for three months to avoid amputation.

Complicated injuries, such as compound fractures, were regarded with more trepidation since they often necessitated amputation, a complicated and dangerous undertaking, particularly before the introduction of ether anaesthesia in 1847 (Carpenter, 2010), the acceptance of germ theory, and the introduction of antibiotic measures in surgery. Surgeons understood that the introduction of air to the fractured area was dangerous and could lead to sepsis (Peltier, 1990). John Hunter encouraged the sealing of compound wounds with lint soaked in the fractured patient's own blood (1794) or a poultice soaked in subacetate of lead (1835). Amputations were a common and greatly feared undertaking (Porter, 1985a) and patients were often unwilling to view surgery as a viable option. Much medical and popular literature exists suggesting that practitioners should avoid amputation where possible, epitomized in a 1794 article from *Gentleman's Magazine*, a popular news and opinion periodical, describing the case of an elderly collier who had suffered a compound fracture of his right leg. He refused amputation but was walking with crutches after two months of home care. The author concludes that "however necessary and right speedy amputation may be in great hospitals…this narrative affords a striking proof of the necessity there is for great deliberation in cases where amputation may be thought necessary" (Carter, 1794, p. 448). John Hunter, the preeminent Scottish surgeon, spoke of the surgeon's dilemma when he stated that "with regard to operations, we should know when they will relieve, and when nothing but operations will relieve. We should know when the habit [of the patient] will bear an operation – this is sometimes almost impossible to ascertain" (qtd. in Digby, 1994, p. 89).

Two leading figures in fracture history, Ambroise Paré and Percivall Pott, lived and practiced medicine two hundred years apart, but both suffered and survived compound fractures of the lower limb. Their experiences epitomize the treatment of compound fractures in their respective eras and demonstrate that little changed in fracture treatment between the 16th and 18th centuries. Paré, a French barber-surgeon active in the 16th century, was kicked by his horse and suffered a compound fracture of the left tibia. He was treated by a surgeon whom he begged "not to spare [him] more than any stranger in his care; that in reducing the fracture, he forgot the friendship he bore [him]," (1960, p. 83), providing a clue to the level of pain that was to be endured. After the wound was cleaned of any fragments, the leg was splinted and bandaged and the space between the back of the knee and the ankle was filled with flax compresses wrapped in cloth to lessen pressure on the heel (Paré, 1960). Paré describes the use of "egg white, flour and chimney soot with fresh melted butter" (1960, p. 83) as medication and rose ointment to lessen inflammation, reputedly because it "repels humors from the injured part" (1960, p. 85). Pott was thrown from his horse in 1756 and "suffered a compound fracture of the leg [femur], the bone being forced through the integuments" (1808, p. ix)**.** Being a gentleman of means, he sent for two chairmen to bring their chair poles and had a servant purchase a door to which the poles were nailed, thus creating a makeshift stretcher to carry him to his home for treatment. The fracture was serious enough for surgeons to consider amputation, but the limb was eventually saved (Pott, 1819). According to James Earle, Pott's biographer, the case was "a strong instance of the great advantage of preventing the insinuation of air into the wound of a compound fracture" (1819, p. x). These cases demonstrate that individuals of means were not immune to the dangers of compound fractures. Paré and Pott differ, however, from most of their working poor contemporaries because they recorded their own fracture experiences and were treated in their own homes.

British patients had certain legal rights regarding the treatment of their fractures. If a bone was mending crookedly the surgeon could not rebreak it for the purpose of straightening without a patient's consent (Slater v. Baker & Stapleton, described Faden et al., 1986, pp. 116-117). Further, a patient was entitled to compensatory payment from a surgeon who diagnosed a sprained or swollen limb as a fracture and treated it as such (Harris vs. Worsley, described in Oldham, 1992, pp. 1129-1131). The jury who ruled in favour of the patient, Ann Harris, likely believed that the accused surgeon understood that her elbow was not broken, but sought to charge for a more expensive treatment, a common accusation in cases involving possible fractures (Young, 1890).

2.6 MEDICAL PRACTITIONERS

There were three major groups of medical practitioners operating in London during the "long" eighteenth century. Medicine was viewed classically as a tripartite profession, consisting of physicians, apothecaries, and surgeons (Figure 2.2).

Figure 2.2 – Personifications of pharmacy (apothecaries), medicine (physicians), and surgery; Oil painting after Nicolas de Larmessin II (1638-1694)

The theoretical hierarchy of these groups led Mildred Peterson (1978) to dub them the three estates. The first, the physicians, were gentlemen with medical degrees from reputable universities (Bynum, 2008). Theirs was the oldest group; King Henry VIII incorporated them in 1518 for the treatment of internal complaints (Carpenter, 2010). In comparison to other types of practitioners, they were relatively scarce; physicians comprised less than 5% of medical practitioners in England at the beginning of the nineteenth century (Carpenter, 2010). Apothecaries, the most populous of the three groups, outnumbered physicians in London by approximately ten to one at the beginning of the eighteenth century (Loudon, 1986, p. 21). They were incorporated in 1617 as the Worshipful Society of Apothecaries by King James I (Carpenter, 2010). They were originally restricted to compounding and selling drugs prescribed by a physician, but were often perceived and satirized as capitalizing upon peoples' poor health. The third group consisted of the surgeons. Originally classed with barbers, surgeons were separated into the Company of Surgeons in London in 1745 (Carpenter, 2010). They had a range of duties, including setting broken bones, removing stones and tumours, and often midwifery.

The divisions between physicians, surgeons, and apothecaries were not discrete. Though individuals may have achieved varying degrees of training, general practice, out of necessity or demand, was common. Further, the titles of medical practitioners often bore little resemblance to the totality of their practice; many advertised themselves as "surgeon, apothecary, and man-midwife" or "physician and surgeon" (qtd. in Loudon, 1985, p. 7; Kett, 1964) without holding the necessary qualifications. Though Acts of

Parliament and legislation legally outlined a division of labour, the intermediate areas between surgery and physic, such as venereal and skin diseases, forced medical practitioners to have a wide set of skills. As R. Campbell wrote in 1794, "the physician should know something of the surgeon's business, and he of the doctor's, and the apothecary of both" (1794, p. 52). Following the Rose Case of 1704 (discussed at length in Digby, 1994; King, 1958; Loudon, 1986), apothecaries were legally able to provide medical advice in addition to dispensing medicines. This ruling provided the legal foundation for general medicine in England and "gave legal confirmation to the role of the apothecary as a medical practitioner rather than a tradesman" (Loudon, 1986, p. 23). By the late eighteenth century physicians were plentiful in London, but other types of medical practitioners outnumbered them in the provinces of England (Digby, 1994). The proliferation of medical professionals with wide ranges of experience and credentials often led to acrimonious relations between practitioners. Indeed, "intra-professional conflicts flared between the physicians and the apothecaries, between general practitioners, druggists and chemists, and between the regulars and quacks" (Porter & Porter, 1989, p. 117). Patients, fearing the physician's fee, often consulted an apothecary, who could be counted on to provide a full range of medical services for a lower rate (Barry, 1985; Burnby, 1983). This infuriated many physicians who declared that comparing an apothecary to a university-educated physician "is but to dub the labourer in the brick-kilns, an Architect; or the maker of bellows an Organist" (qtd. in Rosenberg, 1959, p. 53). Patients recognized the differences between the various medical practitioners and sought their services with reference to cost and the perceived severity of the individual case.

2.7 HEALTH AS BUSINESS

It must be considered that "medicine was a business as well as a vocation" (Digby, 1994, p. 19). During the "long" eighteenth century physicians counted the aristocracy, the gentry, and members of the upper and middle classes amongst their patients, a group which comprised about one tenth of the population of England (Digby, 1994). Physicians who made an effort to be visible in fashionable society and who self-promoted effectively could become very wealthy, particularly in London. A top physician practising in London during the mid-eighteenth century could earn between £5,000 and £11,000 annually, and there were outlying individuals earning much more (Digby, 1994, p. 189). A successful London-based physician could make two to five times more income than his provincial colleagues (Thomson, 1857; Verney, 1930). Non-payment of fees was a problem, however, because physicians were unable to recover their fees through legal action (Digby, 1994, p. 195). Gentry families were often slow to pay their bills; a physician could be made to wait for years to recover his fees. Wealthy families often made the assumption that the mere act of associating with a particular physician would benefit his practice and that their individual fee was less important than the reputation a physician could earn by successfully serving the elite (Digby, 1994). Finding and keeping patients who could pay necessitated advertising one's practices. Physicians "live[d] by persuasion and propaganda, by claiming that their service [was] indispensable" (Perkin, 1989, p. 6). The challenge, translating specialized medical skills into an economically viable career, was acknowledged by physicians of the period. Thomas Beddoes, eighteenth-century physician and scientific writer, stated sadly that "our dignity is unfortunately placed in the quantity of our gains, not of the good we do" (qtd. in Porter, 1992a, pp. 142-143). Indeed, surgeon-apothecaries in the eighteenth century ran their practices from shops rather than surgeries (Digby, 1994). Many patients distrusted what they perceived to be the mercantile focus of the medical trade. Georgian cartoons and comic poems refer to doctors as "Sawbones, Fillgrave or Slasher" (Digby, 1994, p. 311) or "Dr. Slop [and] Dr. Smelfungus" (Porter, 1985b, p. 189) and satirically skewer doctors for their supposedly exclusive focus on the collection of fees. The mercantile angle of medical practice inspired passionate satire. Matthew Prior, in 1763, wrote: "You tell your doctor, that y'are ill / And what does he, but write a bill" (qtd. in Porter & Porter, 1989, p. 57). In this sense "bill" refers to both the doctor's prescription and the fee expected for treatment.

Fees for physicians or apothecaries, though not for surgeons, became legally defined as gratuities during the eighteenth century, meaning that a patient was bound to pay for their medicine or physic, but could decline to pay for a physician's time, advice, or services (Crawford, 2000), a law that was not amended until the Medical Act of 1858 (Cooke, 1972). Because they could not sue for their fees, physicians and apothecaries were put in the unenviable position of courting favour from their patients and developing good reputations to encourage payment. The law was satirized by artist William Heath in 1823 in a print displaying a gentleman examining an extensive medical bill and declaring to his servant: "Tell the Doctor I will certainly *pay* for the *Physic* but shall return the *Visits*!" (reproduced in Digby, 1994, p. 219). Some physicians sought to circumvent the law by rolling their fee into the charges for medicines, but could not raise prices too high, wishing to remain competitive with the independent druggists whose trade multiplied in the late eighteenth century (Crawford, 2000; Loudon, 1986).

Physicians railed against those they viewed as quacks or unqualified practitioners, stating that the profession is "quite overstocked" without needing to worry about the interventions of speculators in medicine (Simpson, 1981, p. 18). Labelling competitors as quacks was a form of abuse in the eighteenth century; the term became increasingly common after 1815 (the Apothecaries Act) as the number of practitioners across England rose, increasing competition (Digby, 1994). The term 'quacks' was used to mock advertisers, empiricists, or untrained practitioners (King, 1958) available in the metropolis. These individuals went by many names, including herbalists, wise women, good samaritans, bonesetters, ladies of the house/manor, mountebanks, horse-doctors, empirics, tooth-drawers, drug peddlers, showmen, witches, barbers, and charlatans (Bynum, 1994; Porter, 1985b). Quacks were largely itinerant and developed their trade through selling pre-packaged medicines rather than developing a localized practice with regular patients (Porter, 1986). Mister W. Elmy, who touted himself as a "Professor of Physick," advertised a pill that he claimed had the ability to:

> cleanseth the Blood from all Impurities, Infallibly Curing the Scurvy…it Cures the Head-ach to Admiration, taking away Vapours offensive to the Brain: It creates a good Stomach and Digestion, takes away sharpness of Urine, cleanseth the Reins,…it Cures all Joynt-Pains, resists Fevers and Surfeits, and preserves the Body in perfect Health (Old Bailey Proceedings Advertisements, 1699).

Surgeons resented the competition the bonesetters represented and, in some cases, commented disparagingly about their work in their own casebooks. A surgical student at St. Thomas' Hospital in 1725 described two individuals, a young male and a woman, who were brought to the hospital with elbow injuries. The student, concerning the young man, comments "what means had been us'd I know not, but I doubt not his being carried to A Hyde park bone setter;" he later refers to the bonesetter's techniques of dislocation and fracture reduction as "pulling & Hauling" (KCL, GB 0100 TH/PP44, n.p.).

Nostrums and medicines peddled by quacks were often cheaper than those prescribed by physicians and individually prepared by apothecaries. Further, quacks' wares often tasted better since, in many cases, sugar and alcohol were added to sweeten the mixtures (Porter & Porter, 1989). Ill individuals could choose the services of many practitioners and their independence was heightened by the publication of self-help tomes such as John Wesley's *Primitive Physick* (1747), which championed natural holism and cold water therapy, William Buchan's *Domestic Medicine* (1769), which proposed a philosophy of health based upon hygiene and temperance (Porter, 1992b), and the anonymously published *The Ladies Dispensatory, or Every Woman Her Own Physician* (1739) which included detailed advice on pregnancy and labour. These volumes, published in English rather than Latin to appeal to a lay medical audience, went through many editions, indicating the popularity of self-help. Followers of Buchan's volume were so numerous they were dubbed his "Buchaneers" (Porter & Porter, 1989, p. 199). Medical self-help resonated with Enlightenment philosophers, who encouraged self-help and civil improvement as a result of the revival of ancient ideas concerning individual and environmental health improvement (Borsay, 1989; Corfield, 1982; Marland, 1987; Porter, 1991a; Wear, 1993).

A particularly well-known alternative practitioner was Sally Mapp, or Mrs. Mapp the bonesetter, who was active in the early eighteenth century. Her brusque manner and apparently slovenly appearance were widely mocked by contemporary cartoonists such as George Cruikshank and William Hogarth. Further, Percivall Pott, in the introduction to *Fractures and Dislocations* described Mrs. Mapp 32 years after her death as "an ignorant, illiberal, drunken female savage" (1769, p. 2). The rancor against Mrs. Mapp appears to stem from physicians' distrust of medical practitioners without recognized licenses and the competition that alternative medicine created. The apparently miraculous cures effected by Mrs. Mapp, such as straightening the long-broken backs of crippled individuals, were celebrated in newspapers and in a comedy play staged in 1736 entitled *The Husband's Relief, with the Female Bone-setter and Worm-doctor*. The play featured a song with the lyrics: "Dame nature has given her a doctor's degree, she gets all the patients, and pockets the fee," (Cabinet of Curiosities, 1824, p. 189). These lyrics reveal a major concern of the eighteenth-century physician – competition for patients' fees.

2.8 THE WORKING POOR AND THE VOLUNTARY HOSPITAL MOVEMENT

"[T]his HOSPITAL;
This noble monument of human worth; …
Blest institution! as in all the rest,
So much in this—*the cure of accidents!"*
(Wilde, 1810, pp. 3, 55)

The medical marketplace served individuals who could afford to pay for their care. The rest of the population who generally could not fell into two groups: paupers and the labouring poor. Eighteenth-century London society "distinguished those who were poor from those who were destitute, and likely to remain so" (Rivett, 1986, p. 28). The destitute individuals, or paupers, were those who were "blind, lame, impotent [read: disabled], old and such others unable to work" (Barry & Carruthers, 2005, p. 154). Following the Elizabethan Poor Law Act of 1601, these individuals were to be provided for by their parishes or accepted into poorhouses or workhouses. The other group was known by various sobriquets, including the labouring poor, the working poor, or the sick poor. Under the Poor Law, these individuals were eligible to receive "outdoor relief" comprised of bread and a small sum of money to allow them to stay in their homes and avoid dividing families (Clark, 1997, p. 187). Able-bodied individuals were eligible in their parish of settlement. One's eligibility for support in a parish could be gained through birth, marriage, landholding, or employment (Levene, 2006, p. xi). The Poor Law did not definitively establish the amount or regularity of relief provided; further, it did not "provide a comprehensive system of full subsistence support" (King, 2006, p. xxxv), meaning Poor Law provisions were only one source of support the poor may have sought to access.

Historians have wrestled with labelling the "poor," since this group of people was not homogenous or clearly differentiated (e.g., Lees, 1998; Rimstead, 2001). Poverty was "fluid and subjective in its definition" (Levene, 2006, p. ix) and people could change statuses throughout their life course. Relatively few individuals spent their entire lives dependent upon poor relief (King & Tomkins, 2003). There is evidence that these groups were not always clearly differentiated; indeed, the division was "porous for contemporaries, and that there were very fuzzy margins between the indigent and the mass of the labouring population" (Levene, 2006, p. ix). It was difficult to keep a count of the settled poor since "most communities experienced significant flows of return migration, some of those who were settled paupers at one point in time might have been in the past, or might subsequently become, out-parish paupers" (King, 2006, pp. xlix-l). There were, however, efforts by eighteenth-century lawmakers to identify and define what individuals comprised "the poor." The labouring poor were identified as a group worthy of medical care and unique from the paupers, middling sort, and upper classes:

> It provides for the relief and comfort of Multitudes who are unable to be at the expence [sic] of Advice or Physick, but are not distinguished by the name of THE POOR, because They do not come under the care of a Parish or Workhouse; and yet are the principal objects of this Charity, and most of all entitled to the regards of the Public; since They are in present want; and are of the diligent and industrious, that is, of the useful and valuable part of all Society (Winchester County Hospital, 1737).

The working poor generally depended upon home remedies or the services of quack doctors before the advent of general hospital facilities. These individuals were deemed the "deserving poor," those whose acceptance into the hospital would "[protect them] from the trickery of quacks…and by the preservation of their lives the nation benefited; for people meant wealth" (Howie, 1981, p. 346).

The working poor were a varied group of people, including those who were dependent upon wage labour and those who received poor relief or charity (Dyson, 2014). Living off the land was no longer a viable option and as people increasingly moved into the city, they turned to domestic industry and artisan work as a means of survival (Clark, 1997). Tradespeople did not enjoy secure positions and the risk of falling upon hard times was ever-present (Clark, 1997). Most individuals lacked savings or property to fall back on in hard times. Hanly (2003) notes that many families survived with a combination of pooled earnings and parish poor relief. Family economies often depended upon both parents to be working due to the low wages afforded to journeymen and the seasonal nature of many employments. A 1768 letter from a journeyman's wife to the *Public Advertiser* explains that though her husband never drinks, his wage of 19 shillings was insufficient to support the family; she was working to purchase clothes and cover the rent (quoted in Dobson, 1980, p. 112). Many women worked in female-dominated trades such as charring and laundry work, nursing and midwifery, and needlework (Earle, 1989). The working poor also incorporated migrants, who could not provide proof of residency and were therefore ineligible for poor relief (Snell, 2006; Wallace, 2000). New immigrants comprised approximately 1/3 of the population of London in 1821 as immigration from the countryside continued to rise throughout the "long" eighteenth century (Schwarz, 1976). The poor made their living in what has been variously termed an economy of makeshifts (Hufton, 1974) and a mixed economy of welfare (Innes, 1996), terms for the "patchy, desperate and sometimes failing strategies of the poor for material survival" (Tomkins & King, 2003, p. 1). Lees (1998) posits that most of the labouring poor likely had to apply to their parish for assistance at some point during their lives.

When in dire straits the working poor had several options from which to choose. Some were able to access poor relief or charity and many were members of Friendly

Societies (Gorsky, 1998; Jones, 1985; Wallace, 2000). Friendly Societies were groups of men or women (but never both) who formed a club to socialize and contribute money towards a collective fund (Wallace, 2000). These funds could be used for emergencies such as acute sickness, loss of property due to fire, imprisonment for debt, or to pay for funerals (Clark, 1997; Wallace, 2000). The Friendly Society Act of 1794 required these clubs to register in England and be listed publicly. There were a total of 542 clubs registered in London, of which 15% were female clubs (Clark, 1997, p. 36). Strict rules kept these societies running smoothly and differed little between the various clubs. Age limits were in place and members were to be of a particular professional status (e.g., must make at least x shillings per week) (Wallace, 2000). Common exclusions were individuals who participated in "hazardous of pernicious trades or calling" (Wallace, 2000, p. 56) such as brick makers, labourers, chimneysweepers, watermen, and hackney coachmen. Individuals involved in the prison system or militia were often excluded, as were Catholics and the Irish (Wallace, 2000). These societies were, therefore, not accessible by all individuals, least of all recent immigrants or those who were making their living on the street. Members of a registered Friendly Society were perceived as being capable of paying for their medical expenses, whether from their own pocket or through the Friendly Society group and were generally not admitted to hospital (Howie, 1981).

Shore (2003) argues that criminal activity was "a necessary adjunct" (p. 147) to the poor's makeshift economy as were the use of credit, borrowing money, or pawning goods (Muldrew, 1998; Sokoll, 2000). The petty criminal activities engaged by the poor included “begging and vagrancy, petty theft, receiving, shoplifting and employee theft” (Shore, 2003, p. 150). Theft by servants was a common occurrence; servants were generally hired on short-term contracts. Some crimes were serious enough to warrant the death penalty. Between 1703 and 1772, 62 servants were hanged in London, of these 21 had robbed their masters (Linebaugh, 1993, p. 249). Begging was an illegal activity in eighteenth-century London, but was rarely prosecuted (Hitchcock, 2005). Matthew Martin, of the Society for Bettering the Condition and Improving the Comforts of the Poor, interviewed beggars in the streets of London in 1796 and estimated that there were 15,288 beggars working the streets (Martin, 1803). The majority of beggars were female (Martin estimated 90%) and moved from parish to parish seeking day work (Hitchcock, 2005). Individuals working as chimney sweeps and milkmaids, whose work was tied to the seasons, often supplemented their pay through begging. Shoeblacks and charwomen, for example, existed at the intersection between pauper employment and begging (Hitchcock, 2005). Streetsellers, carollers, May Day dancers, children who collected pennies on Guy Fawkes Day, and women who sold sex were all part of a “moral economy” (Hitchcock, 2005, p. 492) of individuals who were building a “supportable life from the shards and fragments of a complex economy” (pp. 488-489). Hitchcock’s (2005) use of the term “moral economy” differs from Thompson (1971), who employs the term to explore the relationship between social protests by the eighteenth-century English poor in the form of food riots and the setting of grain prices in the markets.

Public life was an important part of the working poor’s existence. Kinship networks could play an important role on individuals’ welfare and the exploitation of this "social and fiscal credit" is another aspect of the economy of makeshifts, dependent upon an individual's circumstances, presence of extended family, and their community of settlement (Hanly, 2003, p. 91; Thane, 2000). Bonds of neighbourliness and friendship were strengthened through public gatherings (Medick, 1983) and both men and women frequented public houses and spirit cellars. Reforming magistrate Patrick Colquhoun wrote in 1794 that the working poor of London "have got into the habit of spending their leisure time in pubs, eating and drinking, quarrelling and gaming" (p. 49). Anna Clark (1997) posits that London was not cohesive overall "as waves of country immigrants seeking work, decayed tradesmen, and ambitious journeyman jostled for scarce housing in old slums and new suburbs" (p. 26), but neighbourhoods were more intimately bonded. Certain tradespeople congregated in particular neighbourhoods such as the Spitalfields silk weavers, tailors and shoemakers of St. James, watchmakers of Clerkenwell, and coachmakers of Long Acre (Clark, 1997). Communities or groups of vagrants and beggars moved amongst neighbourhoods and between parishes depending upon patterns of policing (Hitchcock, 2004, 2005). Moorfields, at the boundary between London and Middlesex, was a popular location for many beggars (Hitchcock, 2005). St. Giles's, the parish served by the Middlesex Hospital, was among the poorest in London and was identified by local magistrates as a site associated with criminality throughout the eighteenth century (Griffiths, 2000; McMullan, 1984).

As the population of London grew, so did the number of hospitals. Enlightenment ideals encouraged charitable giving and London became a focus of charity since it was a place where "the middle and professional classes were particularly in evidence, where funds were most easily gathered, and where social problems were most visible" (Levene, 2006, p. xiii; Langford, 1989). The eighteenth century has been referred to as the Age of Hospitals (Dainton, 1961) in reference to the expansion of medical care during this period. Specialized centres of medicine for smallpox (e.g., Smallpox Hospital), venereal disease (e.g., Lock Hospital), mental illness (e.g., Bethlam Royal Hospital, nicknamed Bedlam) and pregnancy (termed lying-in hospitals) (e.g., General Lying-In Hospital) flourished alongside general establishments. By mid-century there were seven general hospitals providing approximately 2000 beds (Lane, 2001) and offering medical care to the labouring poor deemed deserving in London.

Many historical accounts characterize eighteenth-century hospitals as "gateways to death" (Helleiner, 1957, p. 6), stating that "the chief indictment of hospital work at this period is not that it did no good, but that it positively did harm" (McKeown & Brown, 1955, p. 125). The poor reputation of eighteenth-century hospitals is being re-examined in contemporary medical historical literature (e.g., Anderson, 2007; Cody, 2004). It is clear that the dangers of hospital-acquired infection or disease were real (Risse, 1986), but the overly pessimistic view of the eighteenth-century hospitals championed by McKeown and Brown (1955) and Foucault (1973) is partially due to the over-citing of Jacques Tenon, a French surgeon who published in 1788 on the deplorable conditions in several Parisian hospitals (see Greenbaum, 1975). All of Tenon's suggestions for improvement were actually based upon the English hospitals he visited in 1787 (Greenbaum, 1971). Physician John Aikin noted the inherent irony in a hospital being a breeding place for disease, but explained that the poor would still benefit from hospital treatment:

> Whoever has frequented the miserable habitations of the lowest class of poor, and has seen disease aggravated by a total want of every comfort arising from a suitable diet, cleanliness and medicine, must be struck with pleasure at the change on their admission into a hospital where these wants are abundantly supplied.
>
> (1771, pp. 79-80)

Bristowe and Holmes noted that

> the general death-rates of hospitals afford no test of the relative salubrity of hospitals. The condition of a hospital death-rate is determined almost exclusively by the character of the cases admitted, and by the rules or practices which regulate their discharge…English rural hospitals have acquired, on false grounds, a reputation for comparative healthiness. By their regulations, their practice, or their position, they receive habitually a far less serious class of cases than is admitted into the hospitals of London
>
> (qtd. in Woodward, 1974, p. 137).

The chance of contracting a hospital disease increased in London toward the end of the eighteenth century as the voluntary hospitals increased admissions and became overcrowded (Risse, 1986). Hospitals were places where the balance of power was shifted to the medical practitioners and it was the poor of England who became the first patients (Digby, 1994; Lawrence, 1996). Though the hospital could be an intimidating place, there is evidence (e.g., Wilde, 1810) that hospitalized individuals "forged strong bonds of solidarity and fellowship" (Risse, 1986, p. 283). Further, working class patients were moved into ventilated wards with clean sheets and clothes, allowed to rest, and fed a regular diet (Risse, 1986). Cherry (1980a,b) asserts that though hospitals may not have had a substantial effect in the treatment of infectious disease, they likely had an overall, if indirect, contribution to improving health. Hospitals aided in getting family breadwinners in a fit state to work and isolated ill individuals from overcrowded homes, but without general improvements in living standards hospitals could not singlehandedly improve the nation's health (Cherry, 1980a).

Two of the general hospitals, St. Bartholomew's and St. Thomas', boasted medieval origins (c. 1123 and c. 1173 respectively). These institutions had been closed during the English Reformation, but were chartered as Royal Hospitals and given to the City of London (Lawrence, 1996). St. Bartholomew's was re-endowed by King Henry VIII after a petition from the Lord Mayor of London and St. Thomas' by King Edward VI. Guy's was founded and personally endowed by Thomas Guy in 1725. Guy, a bookseller and printer, had made a fortune in the South Sea Bubble (Barry & Carruthers, 2005) and gave much of his fortune to charity. The hospital was originally opened to take on the incurable or insane patients from St. Thomas' (Woodward, 1974), but eventually became a general hospital (Barry & Carruthers, 2005). These three hospitals were independently endowed and could survive without appealing to the public for donations.

In contrast, the Westminster, St. George's, the Royal London, and the Middlesex depended upon donations, subscriptions, and fund-raising events to provide charitable care for London's poor. These voluntary hospitals were founded upon "a wave of philanthropy by those who wished not merely to alleviate distress but to restore the afflicted to respectable and independent citizenhood" (Rivett, 1986, p. 25). The voluntary institutions depended upon charitable subscriptions, which made up 50 to 75% of their income (Risse, 1986). Other funds were raised through legacy donations and benefit events such as concerts and anniversary dinners. The Westminster was the first voluntary hospital in London, founded in 1720 (Woodward, 1974). The other three voluntary hospitals, St. George's in the west, the Middlesex in the north, and the Royal London in the east were all built on the peripheries of London, where open land was more plentiful (Rivett, 1986).

The criteria of who was considered deserving of admission to the general hospitals excluded servants and apprentices (it was determined they should receive medical care through their employers), paupers, and individuals from the workhouses. Various contemporary sources note that individuals accepted into the general hospitals should be "deserving" or "worthy objects of charity" (Woodward, 1974, p. 40), since the hospitals were serving to "[recover] future wealth potentially lost to the nation" (Lawrence, 1996, p. 45). John Bellers, writing in 1714 aptly characterized the social class differentiation inherent in the voluntary hospital system by stating that "it is as much the duty of the poor to labour when they are able as it is for the rich to help them when they are sick" (p. 6). Individuals could gain access to these institutions if they were recommended by a benefactor, known as a Donor, Subscriber, Trustee, Governor, Proposer, or Recommender (Hart, 1980; Lane, 2001). These benefactors, through their donations or subscriptions to the hospital, secured the right to recommend a designated number (dependent upon the size of the donation) of inpatients and outpatients for hospital care (Hart, 1980). Subscribers who paid their charitable dues on time were generally allowed to sponsor one to three patients annually (Risse, 1986). Previously, due to an Act of Parliament in 1662, poor individuals could only seek medical care in their own parish, a system that became difficult to regulate with increasing immigration and mobility within London (Lawrence, 1996). Prospective patients needed a hospital subscriber's recommendation to secure hospital admission, unless the individual had suffered an accident (Cherry, 1980b). The subscriber could be an individual, township, or parish (Woodward, 1974). At the endowed hospitals each case was considered individually, while at the Royal London an individual could go through a subscriber or petition the hospital by paying a penny (Woodward, 1974). The endowed hospitals charged a deposit, often termed "caution money" (Hart, 1980, p. 452), upon entrance to cover bed linens, washing, and possible burial (Lawrence, 1996), while the voluntary hospitals did not. In 1788, St. Bartholomew's charged a deposit of 17s 6d, to be returned if the patient was discharged. Guy's charged a fee of 20s (Howard, 1791). The Westminster and Royal London hospitals did not charge a burial deposit, but even the most destitute families attempted to avoid the socially shameful fate of having their loved one buried at the expense of charity (Fowler & Powers, 2013). Some contemporary observers criticized the burial security payment, accusing the hospitals of epitomizing the "spirit of penurious economy which makes charity appear so unlike itself" (Aikin, 1771, p. 55). Though the payment may have frightened inpatients, most voluntary institutions had low mortality rates (Risse, 1986).

General hospitals sought to provide care for injuries and illnesses deemed curable. These institutions did not provide general care in the modern sense; rather, they were not specialized for the care of specific ailments and excluded individuals suffering from chronic or infectious diseases. The general institutions commonly excluded the following types of cases: "no woman big with child, no children under seven years of age (except in cases of compound fractures, amputations, or cutting for the stone) no persons disordered in their senses, or suspected to have Smallpox, Itch, or other infectious distempers, or who are judged to be in a consumptive, asthmatic, or dying condition" (London Hospital, 1762). Essentially the hospitals were attempting to limit the admittance of "burdens on the house" (Aikin, 1771, p. 52); that is, chronic or incurable cases that might turn the hospital facilities into almshouses. There were exceptions to these rules; the Middlesex had a lying-in ward from 1747 to 1807 and the Royal London practiced midwifery (Woodward, 1974).

Contemporaries also stressed the religious benefits that could be gained through funding hospitals; high-ranked clergymen were often found on the Board of Trustees of the voluntary hospitals (Woodward, 1974). The religious benefits of hospitals echoed the "attitude that sickness was an affliction from God to be borne in the best possible spirit" (Woodward, 1974, p. 13). The Westminster Infirmary, London's first voluntary hospital, was founded to care for the physical and moral ills of the poor; the founding members declaring that "the Society designs to reclaim the souls of the sick" (Humble & Hansell, 1966, pp. 6-7). Charity and healing were the ultimate goals of the institutions and Thomas Guy was reported to have stated that "on discharge from hospital, patients were for a time too weak and ill to earn their living" (Hart, 1978, p. 398). Aid was thus provided for many discharged patients, including monetary assistance, clothing, medical supplies such as crutches and wooden legs, and food (Hart, 1978). At the Royal London Hospital this aid was known as John Edwin donations, after a Governor of the Royal London Hospital, who had bequeathed £20 per annum to defray the costs of food and clothing for individuals leaving hospital who may be unable to work for a time (Hart, 1978).

Table 2.1 Founding dates and locations of London's seven general hospitals

Hospital	**Founding Date**	**Location**	**Finances**
St. Bartholomew's	1123 1546 (Royal Charter) 1739 (enlarged)	Smithfield	Endowed (Church lands and revenue), further legacies and donations
St. Thomas's	c. 1173 1551 (Royal Charter) 1730s (enlarged)	The Borough, Southwark	Endowed (Church lands and revenue), further legacies and donations
Guy's	c. 1725/6	The Borough, Southwark	Endowed, further legacies and donations
Westminster	1719/20	St. James	Voluntary (legacies, donations, subscriptions)
St. George's	1733	Hyde Park Corner	Voluntary (legacies, donations, subscriptions)
Royal London	1740	Whitechapel	Voluntary (legacies, donations, subscriptions)
Middlesex	1745	Charles St.	Voluntary (legacies, donations, subscriptions)

Adapted from Barry and Carruthers (2005), Lawrence (1996), and Woodward (1974).

2.9 THE PATIENT AS PARTICIPANT

The harshest critiques of medical history's lack of patient awareness have come from Roy Porter (1985b) who noted that "we lack a historical atlas of sickness experience and response, graduated by age, gender, class, religious faith, and other significant variables" (p. 181) and observes that "it takes two to make a medical encounter" (p. 175). Further, Woodward and Richards (1977) join Macalpine and Hunter (1974) in lamenting that the unknown or unnamed patient is woefully lacking a voice in the history of medicine. Historians such as Douglas Guthrie (1945) and Roy Porter (1985b) have expressed disappointment that the patient has traditionally been neglected in medical history and seek the return of a human face to the history of medicine (Thompson, 1978). The major challenge is determining patients' illness behaviour (Mechanic, 1962) and how it was shaped by their social context. Foucault in *The Birth of the Clinic* (1973) posits that the patient is a creation of the medical gaze; individuals play roles scripted by the medical system. This sociological re-imagining of the medical system serves to further de-individualize patients of the past, particularly those who may have been illiterate or chose not to record their medical encounters. The challenge of reintroducing the patient into the history of medicine has been met by historians such as Roy Porter, editor of *Patients and Practitioners* (1985) and co-author of *Patient's Progress* (1989), volumes in which the role of the patient in medical interactions is considered with equal weight to the role of the medical professionals. These works have revealed that patients did not helplessly wait for a cure, but rather took an active interest in their treatment and long-term care. These volumes stand in contrast to efforts before the 1980s that focused primarily on national health statistics or famous patients, such as *Boswell's Clap* (Ober, 1979).

Certain literate patients, such as Samuel Pepys, left detailed records describing their health and medical care. Pepys's famous diary records events between 1660 and 1669; in this document he mentions illnesses of his wife, friends, and self at least 1017 times (Porter, 1985b). Porter argues that Pepys was not a hypochondriac, but instead that health was a crucial concern, worthy of recording. Pepys discusses his aches, boils, colds, and diarrhea in detail, often blaming cold weather as the culprit. It would be a mistake to generalize the average patient's experience of illness during the "long" eighteenth century from this document. Many other sufferers, such as Ralph Josselin, vicar of Earl's Colne and Pepys's contemporary, recorded his illnesses and characterized them as divine punishment demonstrating the role of Providence in everyday suffering (Beier, 1985; Josselin, 1976; Macfarlane, 1970). Others treated their failing bodies with humour; David Hume, whilst dying of cancer, wrote "my body sets out tomorrow by Post for London; but whether it will arrive there is somewhat uncertain" (Hume, 1932, p. 315). In 1793, Samuel Johnson wrote that he had "bullied, and bounced and compelled the apothecary to make his salves according to the Edinburgh dispensatory…I have two on now of my own prescriptions" (qtd. in Wain, 1976, p. 190), thus epitomizing the affluent eighteenth-century patient's relationship with medicine (Kaba & Sooriakumaran, 2007; Wild, 2000).

Medical consultation letters provide a unique opportunity to explore the intimate details of past patients' illnesses. These missives allow historians access to an expression of individuals' bodily experience (Pilloud & Louis-Courvoisier, 2003), providing clues as to how people embodied and experienced their symptoms and pain and may have described their condition to an attending physician. Studies of patients' consultative letters suggest an interdependence between body and soul and are often "tainted with moral and personal tones" (Pilloud & Louis-Courvoisier, 2003, p. 471). Contemporary sufferers describing their illnesses in diaries or letters often struggled to accurately express their symptoms (Keele, 1957; Scarry, 1985), generally invoking humoural metaphors such as "location, movement, pattern, intensity, emotional response, hotness or coldness, moistness or dryness, and sharpness or heaviness" (Smith, 2008, p. 465). This common language allowed physicians and patients to communicate on the same level despite possible class differences.[1] Communication between physicians and patients created a pidgin medical lexicon. Descriptions of sickness and injury by lay people included colloquialisms, vulgarisms, and dialect-specific words while medical practitioners used what Jonathan Swift referred to as the "hard names" (1948, p. 512) of the medical establishment – the Latin and standard English terms (Porter & Porter, 1989). Joan Lane, in studying reams of diaries and correspondence kept by eighteenth-century sufferers, notes that "patients' responses to illness varied greatly, but a strongly fatalistic strand [characterizes much of the correspondence] as well as a stoicism towards personal suffering almost incomprehensible to the modern reader" (1985, p. 217). For example, a patient writing to physician James Simpson recalled his pre-anaesthetic amputation by saying that "suffering so great as I underwent cannot be expressed in words, and thus

[1] Interestingly, many of the possible descriptions of pain that may result from these descriptions resemble options on the McGill Pain Questionnaire (Melzack, 1975) currently employed in many physicians' practice.

fortunately cannot be recorded" (qtd. in Loudon, 1986, p. 73; Robinson, 1946). Physician Thomas Beddoes bemoaned the fact that "language has not yet been adjusted with any degree of exactness to our inward feelings" (qtd. in Porter, 1991b, p. 282). These authors were usually members of the emerging middle or upper classes.

The journals and letters of wealthy and literate individuals such as Pepys and Johnson stand in stark contrast to the literature available concerning the labouring poor. Written evidence regarding patients' experiences is minimal and is generally reported by physicians and surgeons rather than the labouring poor individuals themselves, who one commentator patronizingly describes as "for the most part illiterate or at least inarticulate" (Howie, 1973, p. 535). A rare example of a hospital patient's personal experiences survives in the poem *The Hospital* (1810), written by actor Joseph Wilde concerning his stay in the Devon & Exeter Hospital. In three volumes, Wilde, through the character of *Thespis*, describes his knee injury, suffered whilst acting in a pantomime as "his sad story / How on the stage, in cursed, pantomime, / (That sole opprobrium of dramatic art), / He fell; and by the fatal accident, / The knee, that curious articulation, / Receiv'd the rude concussion" (1810, p. 15). He describes the pain in his knee as a "mutilated limb with anguish throbbing" (180, p. 15) and his recovery as a period of "painful, lonesome, long decrepitude" (1810, p. 25). Wilde describes the terrifying scene of a labourer who had suffered a fractured skull due to a fall. The scene is characteristically verbose, with Wilde stating that:

> this poor man, destin'd to the builder's calling,
> Besides enduring summer's scorching heats
> And winter's piercing cold, with constant toil,
> Is, from the nature of his calling still

> In hourly danger too. In haste descending,
> To leave the labours of his lofty station,
> And taste the comforts of his cheerful home,
> On the frail ladder's topmost round he steps;
> His footing fails him, and with hideous crash
> Headlong he falls, a senseless weight to earth
> (1810, pp. 51-52).

His fractured skull is described as "th' enormous wound appears: / The skull, deep gash'd, leaves little room for hope. Cover'd with blood" (Wilde, 1810, p. 52). The surgeons are called and treat the man, "the dreadful fracture found, with utmost art, / Beyond the poet's skill to celebrate, / Is now reduc'd; then bound with nicest care" (Wilde, 1810, p. 54).

Experiences such as those described by Wilde are, in many cases, lost. The majority of knowledge concerning fracture experiences is drawn from the writings of literate male patients such as Samuel Johnson, Samuel Pepys, Percival Pott, and Ambroise Paré.

2.10 SUMMARY

Broken bones were a common injury in London during the "long" eighteenth century and individuals of the labouring poor class had various treatment options available to them, including the general hospitals. Despite the continued reign of humoural theory, physicians and surgeons diagnosed fractures with regularity. The voices of the working poor have often been mute in historical research concerning health care during the "long" eighteenth century since it was the literate elite that was most commonly recording their experiences with health care. This research will amplify the voices of the working poor through employing primary documents and skeletal remains to explore the fracture experience of both male and female individuals of the lower class in London during a time of dynamic industrial and medical transformation.

CHAPTER 3.0 – METHODS AND MATERIALS

3.1 INTRODUCTION

This chapter explains how the skeletal collections and archival record holdings under study were identified and accessed. The first section of the chapter addresses the historical backgrounds of the cemeteries from which the skeletal samples were obtained, the criteria for including individuals in the skeletal sample, a discussion of excluded individuals, the methods for sex and age estimation, and fracture recording methodology. The second section of the chapter outlines the data collection process undertaken at various London archives and discusses the issue of data quality. Contemporary nosology surrounding fractures is addressed and I discuss how I sought to estimate the sex, age, and length of stay in hospital of individuals admitted to hospital for a fracture who were recorded in the historical hospital admissions records. At the conclusion of the chapter there is a tabulated summary of exclusions and the final archival study sample, as well a discussion of the statistical methodologies employed.

3.2 SKELETAL COLLECTIONS

3.2.1 Materials

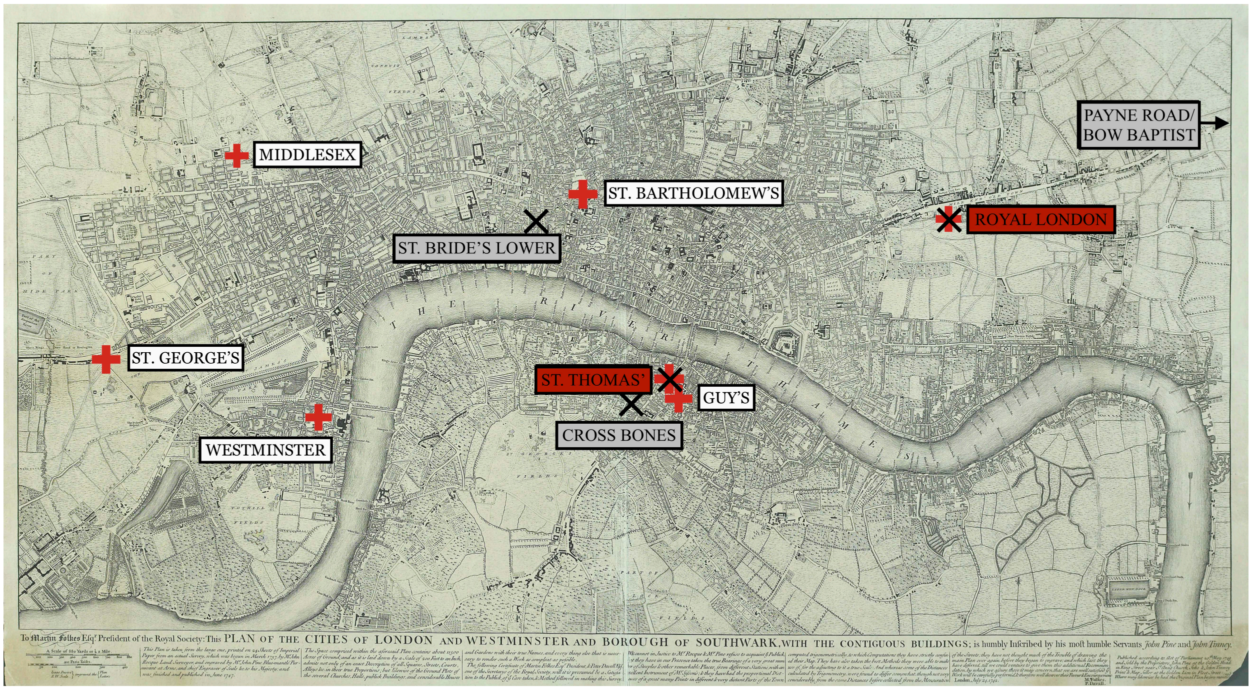
Five post-medieval skeletal collections derived from archaeologically excavated cemeteries were identified through consultation of the Museum of London's Centre for Human Bioarchaeology online cemetery summaries. These cemeteries were known to include lower and/or working-class individuals; all are curated at the Museum of London

(MoL) Centre for Human Bioarchaeology. The sites and their MoL site codes are displayed in Table 3.1; the sites are marked on Figure 3.1. The names of the sites will be used throughout this study, but individual skeletons will be referred to using their site code and individual identifying number. For instance, individual 114 from the Cross Bones cemetery will be referred to as REW92 114.

Table 3.1 Museum of London cemetery and adult (18 years +) skeletal sample overview

Cemetery Site	**Museum of London Site Code**	**Cemetery Use Dates (Skeletal Sample Date)**	**Number of Skeletons Studied**
St. Bride's lower churchyard	FAO90	1770-1849	315
St. Thomas' Hospital	NLB91	17th century	64
Cross Bones	REW92	17th century – 1853; mid-19th century	39
Payne Road and Bow Baptist	PAY05/BBP07	1816 - 1854	193
Royal London Hospital	RLP05	1825-1841	110
Total			**721**

Figure 3.1- John Rocque's 1746 map of London with cemetery and hospital sites marked



(Courtesy of the Museum of London Picture Library, London)

Legend: Voluntary hospitals are marked with ✚ . Cemetery sites are marked with ✖ . Parochial cemeteries are marked in grey. Hospital cemeteries are marked in red.

3.2.2 Historical backgrounds of cemeteries

3.2.2.1 St. Bride's lower churchyard (FAO90)

St. Bride's lower churchyard is located within the parish of St. Bride's, London on Farringdon Street. The lower churchyard is one of three burial locations in the parish; the other two, the main churchyard and the church crypt, are associated with St. Bride's Church, Fleet Street. Parish records show that in 1800 the population of the parish was 7078 individuals, while the total number of occupied houses was 830 (Miles, 2010). The registrar of St. Bride's noted that between 15 and 20, and sometimes 30 people were living in one house (Miles, 2010). Parish burial grounds generally charged different rates depending upon the burial location in the cemetery; St. Bride's had no such differentiation and therefore it was the poorer members of the parish, lodgers, inhabitants of the Bridewell workhouse, and individuals from the Fleet prison who were laid to rest in St. Bride's (Kausmally, 2008). Fleet Prison was mainly inhabited by debtors and a total of 41 former prisoners were buried in the lower churchyard (Miles, 2010). Most individuals in the 1990 Museum of London Archaeological Service excavation were discovered to have been buried in wooden coffins, mainly elm, stacked up to eight deep in the open yard, while 47 were found in a brick vault. The cemetery was likely created due to overcrowding in the St. Bride's Church crypt and churchyard, and it was used between approximately 1770 and 1849 (Miles & Conheeney, 2005).

3.2.2.2 Cross Bones (REW92)

The Cross Bones cemetery is located to the west of Redcross Way in Southwark, London. This burial ground may have been established as early as the seventeenth century as a single women's (read: prostitutes') cemetery, but by 1769 it had become a cemetery for the poor of the parish of St. Saviour's, Southwark (Brickley & Miles, 1999). Approximately 18% of the burials in Cross Bones were individuals from the Southwark workhouse. Overcrowding was an issue in Southwark; between 1710-11 and 1801, the parochial population increased by over 11%, but the number of houses remained the same (Brickley & Miles, 1999). Similar to St. Bride's lower churchyard, individuals were buried in stacked wooden coffins (Brickley & Miles, 1999). Burials excavated by the

Museum of London Archaeological Service in 1992 represent less than 1% of the total number of burials that were made at Cross Bones during its tenure as a burial ground and represent individuals from the later (mid-nineteenth century period) period of the cemetery's use (Brickley & Miles, 1999).

3.2.2.3 Payne Road/Bow Baptist (PAY05/BBP07)

Bow Baptist Church was founded on 21 June 1785, when Bow was a large village outside London, located between the parish church of St. Mary, Bow and the River Lea (Henderson, Miles, & Walker, 2013). The village was comprised of about 2000 inhabitants at the beginning of the nineteenth century (Henderson et al., 2013). The village boasted a blacksmith's forge and a number of businesses, including "Ye Olde Bowe Taverne" which specialized in serving travellers between London and Essex (Lynn, 1935, p. 3). A single surviving burial register covers the period from 13 April 1816 and 1 July 1837, though the burial ground was not closed until the end of 1853 by Order of Council (Henderson et al., 2013). The register records the place of residence of those buried, the majority of which are poor east London locations (e.g., Stratford, Mile End, Bromley). The majority of individuals were buried in single wooden coffins, though there were eleven individuals buried in triple coffins with lead shells (Henderson et al., 2013). There were six brick-built burial structures (two vaults, three brick-lined graves, and one brick grave cover) discovered in the burial area (Henderson et al., 2013) by Museum of London Archaeology in the 2006 and 2008 excavations.

3.2.2.4 St. Thomas' Hospital (NLB91)

St. Thomas' Hospital had medieval origins and was dedicated to St. Thomas the Martyr. The hospital closed in 1540 when King Henry VIII dissolved the monasteries, but was re-opened by King Edward VI and operated as an endowed institution. The hospital was later rebuilt in the eighteenth century. Documentary evidence in the form of governors' meeting minutes from 1697 indicates that there were three burial grounds associated with the hospital (Jones, 1991). The burial ground excavated in 1991 by the Museum of London, Department of Greater London Archaeology, was dated to the seventeenth century; the three burial trenches excavated were determined to be either paupers' or epidemic graves. Little is known about when it was closed; the burial ground does not appear on John Rocque's 1746 map of London, so it can be assumed it was closed before that date. Unlike the other cemeteries studied, individuals in this burial ground were covered with shrouds rather than buried in coffins (Jones, 1991). The Museum of London Archaeological Service excavation in 1991 discovered several different types of burial trenches. One trench contained ten individuals who had been buried in layers of three individuals with only a small layer of soil between the layers. The burial fill contained disarticulated bone, suggesting the trench had been cut through earlier burial trenches. Another trench revealed individuals placed directly on top of one another, suggesting a mass burial possibly due to plague (Jones, 1991).

3.2.2.5 Royal London Hospital (RLP05)

The Royal London Hospital, founded in 1740, was built facing Whitechapel Road, in east London. It received its Royal designation in 1990 at its 250th anniversary. It was necessary for hospitals to make provisions for patients who died in care with no one to claim their bodies or pay for burial; these individuals comprise the skeletal sample from RLP05. In contrast to other general hospitals in London (with the exception of the Westminster), the Royal London Hospital did not charge a burial fee; therefore, the hospital charity covered the costs of burial (Fowler & Powers, 2012; Howard, 1791). Excavations undertaken by Museum of London Archaeology in 2006 uncovered burials dating from between 1825 and 1841. In addition to individuals in standard wooden coffins, the excavation uncovered burials comprising skeletal elements from multiple individuals, many of whom showed evidence of autopsy or anatomization. Graves generally contained between one and five stacked burials, though there were outliers with as many as eight (Fowler & Powers, 2012). The remains of the coffins discovered were similar to those found at the Cross Bones burial ground (Brickley & Miles, 1999).

3.2.3 Criteria for Sample Inclusion

This research was conducted exclusively on adult individuals. An adult was defined as an individual aged 18 years or older. Adults were chosen as the focus in order to make meaningful comparisons between the skeletal findings and contemporary archival evidence of hospital admissions. Though children do appear in the historical hospital records, it is overwhelmingly adult individuals who received treatment at

London's voluntary hospitals. Skeletal sex estimation techniques do not allow confident sex estimations to be made for individuals less than 18 years of age. Further, adults would have been responsible for securing their own admission (Risse, 1986; Wilde, 1810) or that of their family members.

Individuals were selected for study if at least 30% of the skeleton was present. This was done to exclude as few individuals as possible while minimizing the number of individuals for whom it would be impossible to assess sex and estimate age due to poor overall completeness. The Oracle Wellcome Osteological Research Database (WORD) maintained by the Museum of London was consulted to determine how many adult individuals with greater than 30% skeletal completeness were present. A total of 811 individuals fulfilled this criterion. Permission was obtained from the Museum of London Centre for Human Bioarchaeology to study these individuals and analysis was undertaken from January 6, 2014 to July 31, 2014.

3.2.4 Exclusions

Individuals whose remains displayed evidence of the following conditions were excluded from the final study sample: Paget's disease, neoplasms, osteomalacia, scurvy, and osteogenesis imperfecta. Each of these conditions has the potential to affect the structural integrity of bone (Aufderheide & Rodriguez-Martin, 1998; Brickley & Ives, 2008; Krane, 1991; Sillence, 1981; Whyte, 1993); therefore, it would be impossible to determine whether or not these pathological processes influenced an extant fracture. Indeed, Paget's disease and osteomalacia are frequently associated with pathological fractures (Brickley & Ives, 2008). This resulted in the exclusion of 15 individuals from the final study sample. Four individuals (RLP05 336, FAO90 1505, FAO90 1608, and PAY05 702) had Paget's disease; five individuals displayed evidence of neoplasms (FAO90 1125, FAO90 1879, REW92 6, PAY05 541, and BBP07 37); four individuals had osteomalacia (PAY05 877, REW92 72, FAO90 1970, and FAO90 1870.1); individual PAY05 103 demonstrated potential scurvy, and individual FAO90 1903 may have been affected by osteogenesis imperfecta.

3.2.5 Methods

3.2.5.1 Adult sex assessment methods

Sex was estimated by examining the skeletal remains macroscopically for 14 sexually dimorphic traits. Two areas, the pelvis and cranium, are most commonly employed to estimate adult sex. Following the example set out by Buikstra and Ubelaker (1994) and drawn from the work of various authors (e.g., Bass, 2005; Hager, 1996; Krogman & Iscan, 1986; Lovell, 1989; Phenice, 1969; Rogers & Saunders, 1993; Sutherland & Suchey, 1991; Ubelaker, 1989a, 1989b; Walker, 2005; White & Folkens, 1991), seven areas of the pelvis were studied to assess sex: the ventral arc, subpubic concavity, medial portion of the pubis, subpubic angle, ischiopubic ramus ridge, greater sciatic notch, and the preauricular sulcus.

In addition, seven aspects of the cranium were examined following Buikstra and Ubelaker (1994) and drawing from the work of various authors (e.g., Acsadi & Nemeskeri, 1970; Bass, 2005; Graw, Czarnetzki, & Haffner, 1999; Keen, 1950; Krogman

& Isçan, 1986; Walrath, Turner, & Bruzek, 2004): the nuchal crest, mastoid process, forehead shape, supraorbital margin, inion (external occipital) protuberance, prominence of supraorbital ridge/glabella, and the mental eminence. If the skull and pelvis were missing or damaged, the assessment of sex was necessarily based upon fewer skeletal features or estimated from the robusticity and/or gracility of post-cranial elements. Multifactorial analysis was employed in an attempt to limit the possibility of misclassifying individuals, following the example of Walker (1995) who outlines how younger males may be misclassified as female or older females as male.

Individuals were assigned to one of five sex categories: male, probable male, undetermined, probable female, and female (after Buikstra & Ubelaker, 1994). In the Results and Discussion chapters the probable categories are combined with the male and female categories and the individuals for whom sex could not be estimated are removed from the final study sample.

3.2.5.2 Age estimation methods

Age was estimated by examining the skeletal remains using a variety of macroscopic methods. The assessment of age in adults depends on the remodeling and degeneration of bone, which may be affected by the interaction of factors such as health status, occupation, nutrition, and genetics (Cox, 2000). Aging techniques have been criticized for under-representing individuals over 40 years of age due to biased methodology (e.g., Konigsberg & Frankenberg, 1992; Paine & Harpending, 1998; Skythe & Boldsen, 1993). A multifactorial method is necessary because osteological aging is an estimate of physiological age based upon the age-related degeneration of skeletal features (Bedford et al., 1993; Kemkes-Grottenthaler, 2002; Kvaal, Sellevold, & Solheim, 1994; Mensforth & Lovejoy, 1985; Saunders, Fitzgerald, Rogers, Dudar, & McKillop, 1992) and the use of "'multifactorial' methods for age estimation are preferable to the use of a single ordinal categorical system" (Konigsberg, Herrmann, Wescott, & Kimmerle, 2008, p. 556). Without associated documentary evidence, such as a coffin plate, it is impossible to assign a chronological age to a set of adult skeletal remains; the examination of skeletal degenerative features allows an individual to be placed in an age range.

Age was estimated by examining developmental and degenerative changes to four features of specific areas of the skeleton: the pubic symphysis (Brooks & Suchey, 1990), the auricular surface of the ilium (Lovejoy, Meindl, Pryzbeck, & Mensforth, 1985), the sternal end of ribs (Iscan & Loth, 1986a, 1986b), and the extent of tooth wear (Brothwell, 1981).

Individuals were assigned to one of five age categories outlined by Connell and Rauxloh (2003).

- Young Adult (YA) = 18-25 years
- Middle Adult 1 (MA1) = 26-35 years
- Middle Adult 2 (MA2) = 36-45 years
- Old Adult (OA) = 46+ years
- Adult = >18 years

These categories were employed to allow for interobserver comparisons between my age estimations and those recorded in the WORD by MoL observers.

3.2.5.3 Identifying and recording fractures

Evidence for trauma provides information about an individual's interaction with the physical and sociocultural environment (Lovell, 2008). The goals of fracture analysis in this study adhere to the basic objectives of trauma studies outlined by Lovell (2008, p. 341):

- to identify and describe lesions in individuals and populations,
- to interpret the social, cultural, or environmental causes of trauma,
- to examine the relationship of trauma to age and sex, and
- to examine the relationship of trauma to temporal and/or geographic patterning.

The palaeopathological literature does not consistently define and differentiate between the terms injury, trauma, and fracture (Judd & Redfern, 2012; Redfern, 2005). Trauma has been defined in the clinical literature as "a physical wound or injury, such as a fracture or blow" (Oxford Medical Dictionary, 2000, p. 670). Lovell (2008) defines trauma as "injury to living tissue that is caused by a force or mechanism extrinsic to the body, whether incidental or intentional" (p. 341). Some authors, such as Roberts (2006) and Boylston (2006), discuss fractures, amputation, trepanation, and weapon injuries as forms of trauma. Bennike (2008) includes fractures, dislocations, and myositis ossificans under the umbrella of trauma, while Mays (2010) considers these and adds a discussion of sharp force weapon injuries. It has been clinically established that an individual experiences more trauma to soft tissue than to the skeleton over their lifetime (Downing, Cotterill, & Wilson, 2003; Johansen, Wahl, & Weisaeth, 2008). These varied definitions demonstrate, therefore, the utility of outlining exactly what aspects of palaeotrauma will be explored through this research.

This research uses the terms injury and fracture. The term injury will be employed in discussions of fracture because the literature on this topic (i.e., Judd, 2002a, 2002b) uses this term. Fractures are defined by Lovell (2008) as an "incomplete or complete break in the continuity of a bone" and may be caused by "either direct or indirect force" (p. 346). Table 3.2 defines the types of fractures and mechanisms of injury that were recorded as fractures in this research.

Table 3.2 Fracture definitions (*adapted from Lovell, 2008, p. 346*)

Fracture Type	Definition
Avulsion	Fracture from tension at ligament or tendon attachment. In the vertebrae, following Maat & Mastwijik (2000), only those that had occurred in adulthood were included.
Complete	Fracture of undetermined type.
Comminuted	Bone is broken into more than two fragments.
Crush	When pressure is placed onto bone, mostly commonly causing the compression of cancellous bone. Categorized as depression (force on one side) or compression (force on both sides).
Oblique	Fracture is a line at an angle to the long axis of the bone.
Transverse	Fracture is a line perpendicular to the long axis of the bone.
Spiral	Fracture is a rotational and angular stress on the long axis of the bone.
Antemortem	Fracture occurred before an individual's death. Evidence of callus formation and remodeling is present.
Perimortem	Fracture occurred at or around the time of an individual's death

This study is concerned exclusively with fractures. Other types of bony trauma, such as myositis ossificans (DiMaio & Francis, 2001; Ortner, 2003), osteochondritis dissecans (Apley & Solomon, 2000), and dislocations (Dreier, 1992; Miles, 2000) were observed and described during the data collection process, but are not included in the final statistical analyses. The hospital records did not, for the most part, differentiate and describe soft tissue traumata that may have included bony involvement. Evidence of cases of healed antemortem blunt force and sharp force trauma were observed during data collection and were included in the discussion of violence-related injuries (Section 3.2.5.7), but not counted as fractures. Blunt force trauma was noted where irregular cranial depressions with signs of healing were observed. Blunt force trauma has been recorded in the forensic literature as the result of blows from a variety of instruments such as pipes, rocks, hammers, bats, and clubs (Rodge et al., 2003; Spitz, 2005; Sulaiman, Osman, Hamzah, & Amir Hamzah, 2014; Wedel & Galloway, 2014) and is more likely to have been caused by an episode of interpersonal violence if it is located on the superior region of the cranial vault (Fracasso et al., 2011; Kremer & Sauvageau, 2009). Sharp force trauma was noted where marked impressions or grooves were present with signs of healing at the margins. Sharp force trauma to bone occurs when a compression or shearing force is applied to bone over a narrow focus (e.g., axe, hatchet, sword, knife) causing discontinuities such as punctures, incisions, and clefts (Byers, 2008). Sharp force trauma may occur to stabbing, perforating, or chopping (Roksandic, Wood, & Vlak, 2007).

Osteochondritis dissecans was not recorded as a fracture in this research. Others have determined this condition to be a fracture (e.g., Resnick & Goergen, 2002), but Rogers and Waldron (1995) note that while the osteochondritis dissecans lesion may be caused by a traumatic force, it may also be assigned to other categories of pathology. There is a circulatory component (Roberts & Manchester, 2005) and genetics may also be a factor (Resnick & Goergon, 2002). The multifactorial cause of osteochondritis dissecans causes it to be outside the scope of this research.

3.2.5.4 Recording methodology

Fractures were observed macroscopically and with the aid of a Keyence VHX-2000 digital microscope. Their location, stage of healing, and, where possible, the angle of injury were recorded. It was not possible to x-ray the remains; therefore, assertion of the angle of injury was only made when the fracture line was still clearly observable macroscopically or there were radiographs available from previous studies. Radiographs taken by the Museum of London were available for some fractures and were used to aid in the determination of fracture type. In most cases it was impossible to macroscopically or radiographically determine the fracture type.

Fractures were recorded according to segment location, that is: proximal third (P3), mesial third (M3), and distal third (D3) following the segment method for long bone trauma outlined by Judd (2002a). Fractures to vertebrae were recorded separately for the vertebral body and neural arch. The scapulae were divided into four zones: the glenoid fossa, coracoid, acromion/neck, and infraspinous portion for fracture recording. This system was chosen to allow interobserver comparisons to be made between my assessments of bone completeness and those of the MoLA staff who undertook the initial assessment using Connell and Rauxloh (2003). All observed fractures were recorded and the total number of elements present was noted.

The true prevalence rates (i.e., number of skeletal elements affected) and crude prevalence rates (i.e., number of individuals affected) for fractures were calculated and expressed as percentages. The determination criteria for total number of elements (N) are summarized in Table 3.3. Segments are divided into proximal (PE), mesial (M), and distal (DE).

Table 3.3 Calculation of total number of elements present

Element	Presence used to determine N
Cranial bone	25-75% of the element (Buikstra & Ubelaker, 1994, p. 6)
Long bones	25-75% of one diaphyseal segment
Carpals, metacarpals, tarsals, metatarsals, phalanges	> 75% of the element (Buikstra & Ubelaker, 1994, p. 7)
Ribs	Number of heads observed (Connell & Rauxloh, 2003, p. 4)
Vertebrae	Centrum and spinous process (Connell & Rauxloh, 2003, p. 4)
Scapula	Glenoid cavity, acromion process, and body (Connell & Rauxloh, 2003, p. 5)
Ilium, Ischium, Pubis	> 75% of the element (Buikstra & Ubelaker, 1994, p. 8)

Differentiating perimortem injuries from postmortem damage to bone is a challenge and there has been significant work undertaken to reduce incorrect identification (e.g., Dutelle, 2011; Haglund & Sorg, 2002; Loe, 2009; Moraitis, Eliopoulos, & Spiliopoulou, 2009; Symes, Rainwater, Chapman, Gipson, & Piper, 2008; Symes, L'Abbé, Chapman, Wolff, & Dirkmaat, 2012; Ubelaker, 1991). The incorporation of forensic experimentation (e.g., Barbian & Sledzik, 2008; Wheatley, 2008) into bioarchaeological studies of violence has served to hone interpretations of skeletal trauma (Berryman & Haun, 1996). The Scientific Working Group for Forensic Anthropology defines perimortem trauma as "a default category in which remains lack evidence of healing and there is no diagnostic taphonomic evidence of postmortem damage" (2011, p. 4).

Postmortem trauma to bone can mimic perimortem trauma due to ground pressure or the handling of remains (Murphy, Gaither, Goycochea, Verano, & Cock, 2010); therefore, a range of characteristics was used to identify perimortem trauma in this investigation. These include a combination of consistent colouring between the bone and the fractured ends (Adams, 2007; Facchini, Rastelli, & Belcastro, 2008; Maples, 1986; Sauer, 1998; Wedel & Galloway, 2014), absence of healing (Sauer, 1998), fragments remaining attached to one another (Berrizbeitia, 2001; Sauer, 1998; Turner & Turner, 1990), sharp and/or irregular edges (Sauer, 1998; Sledzik, 1998; Wheatley, 2008), and internal bevelling (Facchini et al., 2008). Perimortem injuries may also display curling or splintering of bone, in addition to chatter marks (Sauer, 1998). The term perimortem was applied to fractures that demonstrated a combination of these features.

3.2.5.5 Anatomical groupings

For the purpose of meaningful comparison with the hospital admissions records, the skeleton was divided into anatomical groupings. The cranial group included fractures to the cranium and facial skeleton. The torso group included fractures to the sternum, ribs, vertebrae, sacrum, and os coxae. The arm group included the shoulder girdle (scapula, clavicle) and long bones of the arm (humerus, radius, ulna). The leg category included the femur, tibia, fibula, and patella. The hand category included the carpals, metacarpals, and manual phalanges, while the foot category contained the tarsals, metatarsals, and pedal phalanges.

At first it was assumed that "leg" referred exclusively to fractures of the tibia and/or fibula since thigh/femur and knee/patella are frequently differentiated in the hospital admission records. There are, however, individuals admitted to hospital specifically for tibial and fibular fractures. The surgeons' casebooks consulted in this research contain many entries labeled "Fractured Leg," the majority of which describe cases of fractured tibiae and fibulae. It is, however, entirely possible that an individual may have been admitted to hospital with a femoral fracture that was noted in the register as "Fractured Leg," thus the two groups are pooled together in this research.

3.2.5.6 Multiple fractures and injury recidivism

Trauma recidivists are defined in the clinical literature as individuals suffering repeated injuries (Alghnam, Tinkoff, & Castillo, 2016) or, more specifically, patients who access medical care on multiple occasions for different injuries (Dixon, Como, Banerjee, & Claridge, 2013). The term recidivist was introduced to the clinical literature by Reiner, Pastena, Swan, Lindenthal, & Tischler (1990). The authors outlined a clinical model of an injury recidivist, that is, a male individual with a mean age of 26 years, who within a few years of their first admission would suffer another fracture or injury (Reiner et al., 1990, p. 559). Further clinical literature accepted and utilizes this term (e.g., Goins, Thompson, & Simpkins, 1992; Hedges, Dimsdale, Hoyt, Berry, & Leitz, 1995; Kaufmann, Branas, & Brawley, 1998).

Recidivism was applied to bioarchaeology by Judd (2002a, 2002b, 2004), who outlined the following criteria for the investigation of recidivism in archaeological samples:

(1) Adults individuals must be grouped by sex and age;

(2) Data should be grouped as individuals with no fractures, one fracture, two fractures, and more than two fractures; and

(3) All injuries must be included (i.e., skull, long bones, hands, feet, and torso).

As Judd asserts, "in clinical investigation, injury recidivism is determined by the number of times that an individual sought medical treatment for injury, but the exact number of injuries presented on each occasion are often unstated" (2002b, p. 93). In bioarchaeological studies, it is generally impossible to determine the total number of episodes in which individuals suffered multiple fractures that may be observed in the skeleton (due to the remodeling of fracture calluses); therefore, researchers must use the total number of fractures per individual to access recidivism, with the understanding that the clinical definition differs from what is possible to assess in bioarchaeological research. Most bioarchaeological studies therefore describe individuals with multiple injuries (e.g., Goins et al., 1992; Hedges et al., 1995; Hershkovitz et al., 1996; Kaufmann, et al., 1998; Reiner et al., 1990).

An investigation of multiple fractures incorporating a relative timeline of fracture events was possible in this project because individuals were identified who had a combination of healed and healing fractures. Either an individual had one or more fractures undergoing early stage healing in addition to one or more well-healed fractures, or the individual had a combination of perimortem and antemortem fractures. This combination of injuries provides information on the order in which an individual suffered the fractures and provides clues as to possible morbidity and mortality. Repeated injuries were also investigated in the archival records to determine if it was possible to identify individuals who were admitted to the hospital multiple times. Some individuals were admitted to the hospital multiple times for different injuries indicating possible recidivists, while others were admitted multiple times for the same injury, which may indicate the re-breaking of poorly healed fractures. I attempted to identify possible recidivists by noting cases in which the same name appeared more than once, with particular interest if the name appeared in the hospital records within a year of the first discharge date.

The skeletal sample was divided into hospital cemeteries (Royal London, St. Thomas') and parochial/church cemeteries (St. Bride's lower, Cross Bones, and Payne Road/Bow Baptist). Chi-square tests were conducted upon these datasets to determine if there was a statistically significant difference between the hospital and parochial datasets for each skeletal element. Though the Chi-square test does not indicate the strength of the relationship between datasets, it is ideal for comparing sets of frequency data. Where no differences were found the datasets were combined in order to have the largest dataset possible with which to facilitate comparisons with the hospital admissions documents recovered from the archives. The case in which a significant difference was found is described in Appendix A, Table A.9.

3.2.5.7 Identifying violence-related injuries (VRIs)

The methods for investigating violence-related injuries are drawn from Brickley and Smith (2006). The authors studied the incidence and distribution of injuries that are commonly clinically associated with violence: metacarpal fractures, cranial vault fractures, and fractures to the maxillofacial region. The crude prevalence of fractures between males and females is compared using Chi-square statistical tests to determine if there are sex-based differences in the frequency of violence-related injuries. The percentage of individuals with VRIs that have multiple fractures is compared to the percentage of individuals in the pooled group including all fractures using Chi-square statistical tests to determine if there is a statistically significant difference, suggesting that VRIs have a different etiology than other types of fractures.

3.3 ARCHIVAL COLLECTIONS

3.3.1 Materials

This research aimed to consult all relevant extant records from the seven general hospitals operating in London during the “long” eighteenth century. The National

Archives and Wellcome Library jointly created the Hospital Records Database, a publicly accessible database recording both the existence and location of UK hospital records. Scrutiny of this database revealed that archival collections relating to the seven general hospitals were located in eight archives across London: the Wellcome Library, London Metropolitan Archives, Southwark Local Studies Library, Royal College of Surgeons of England, St. Bartholomew's Hospital Archives and Museum, Royal London Hospital Archives Centre and Museum, University College London Hospitals NHS Trust, and King's College London Archives. The Hospital Records Database provides information in broad categories, such as "Administrative: General" and "Clinical and Patients," necessitating further investigation to determine exactly what is held by each archive.

I corresponded with archivists and historians associated with the eight aforementioned archives before arriving in London to determine exactly what records were available. Some collections, such as the documents pertaining to the Middlesex Hospital held by the University College London Hospitals NHS Trust, have yet to be comprehensively catalogued. Very few of the pertinent records have been digitized, making it necessary to visit the archives in person. The only exception is a range of admission and discharge records (LMA, 12 December 1793 – 15 October 1795; H01/ST/B/3/010) from St. Thomas' hospital. These records have been deemed too fragile for consultation by the London Metropolitan Archives, but thankfully are available online as digitized images as part of the London Lives (2012) project.

Records deemed relevant for examination included hospital admission and discharge records, clinical notebooks belonging to house physicians or surgeons, petitions made by hospital subscribers for patient's admittance, case history books, death registers, apothecary reports, and medical student notebooks. While myriad records from each hospital have survived, the data are not equally spread across all institutions. Unfortunately, the key records for this research, the admission and discharge papers, have not survived for all institutions. As Chodorow wryly observed, "the cultural record will be just what got saved because someone put it in a safe place" (2006, p. 373). Many documents have been lost or damaged over time. Bombing in 1941 heavily damaged St. Thomas' Hospital and many records from the eighteenth century were lost from the ensuing destruction. The majority of documents available from St. Bartholomew's are physicians' and surgeons' casebooks, which included fracture descriptions and sketched medical illustrations. Numerous documents, such as hospital steward memoranda books, as well as lecture and case notebooks, were examined and determined to be irrelevant to the research because they did not refer to fractures. The total number of documents consulted include many that were eventually deemed irrelevant; these include for example: the journal of Thomas Baker, surgeon at St. Thomas' from 1732-1770; case records for Guy's Hospital from 1804-1805; the memoranda book of a Guy's Hospital steward from 1725; admission registers from Guy's Hospital for a selection of years between 1726 and 1766; lists of inpatients for all hospitals; and indices to in-patient admission registers for St. Thomas'. These documents either did not refer to fractures or did not list the reason for patients' admissions. The archival records relevant to this research are summarized in Tables 3.4 and 3.5.

Registration, notetaking, and recordkeeping were important to the voluntary hospital movement. Francis Clifton, a member of the Royal College of Physicians of London, recommended that physicians should write casebooks as they are "the plainest and surest way of practicing and improving physic" (1731). Clifton recommended listing the age, sex, temperament, occupation, symptoms, treatments, and outcome of the patient's progress so that physicians would no longer rely upon their memories alone to diagnose disease and would eventually "come to know diseases so perfectly that it will be impossible for them to miss their reward" (1731, p. 21). The hospitals were accountable to the charitable subscribers and thus it was vital to have a general register to calculate annual admissions, deaths, and discharges (Risse, 1986). Admission records were also crucial for keeping track of how many inpatients were recommended by an individual subscriber, each of whom was allowed to recommend a certain number of people relative to the size of their subscription or donation to the hospital. The admissions books of Guy's Hospital and St. Thomas' Hospital, in most cases, list the name and address of the subscriber alongside the name of the inpatient.

Table 3.4 Admission and discharge records, arranged by hospital and range of dates

Hospital	Record Type	Range of Dates
St. Thomas'	Admission and discharge records	20 January 1774 – 10 February 1774 8 December 1774 – 9 February 1775 30 March 1775 – 27 April 1775 24 August 1775 – 7 September 1775 29 February 1776 – 8 August 1776 25 October 1781 – 10 January 1782 10 January 1782 – 25 July 1782 25 December 1783 – 3 June 1784 11 January 1787 – 4 September 1788 26 March 1789 – 13 May 1790 16 September 1790 – 16 June 1791

		12 December 1793 – 15 October 1795 26 May 1796 – 22 June 1797 20 December 1798 – 13 November 1800
Guy's	Admission, discharge, and accident records	28 July 1813 – 26 December 1838
Royal London	Admission and discharge records	1 January 1760 – 31 December 1760 4 January 1791 – 25 December 1792 16 July 1805 – 24 December 1805
Middlesex	Apothecary admission and discharge records	4 March 1760 – 25 December 1764 9 April 1771 – 2 December 1788

Table 3.5 Descriptive archival records, arranged by hospital and range of dates

Hospital	**Record Type**	**Range of Dates**
St. Bartholomew's	Clinical notes by house physician	1777-1781
	Medical notes of William Lawrence	1827-1858
	Notes on orthopedic surgery	1835-1844
	Notes on medical and surgical subjects	1838-1852
St. Thomas'	Petitions made by overseers of the parish of St. George the Martyr for admission	1776-1811
	Surgical student's casebook	1725-1726
Guy's	Petitions made by overseers of the parish of St. George the Martyr for admission	1776-1811
St. George's	Case histories, surgical commentaries, and hospital notes by surgeon Benjamin Brodie	1805-1860
Westminster	Hospital case notes	1802-1804 1817-1818

The hospital admission and discharge papers form the core of this investigation. Records were deemed relevant if admission records included the date, name of individual, and reason for admission. Some institutions did not record reasons for admission or only began recording reasons for admission subsequent to the temporal period under examination; these records were, therefore, excluded. Admission records for the latter part of the seventeenth century at St. Thomas' hospital exclusively record injured sailors under the heading “Register of Wounded Seamen.” These records inconsistently record reason for admission and were excluded because this research seeks to elucidate the experience of the labouring poor, not a specific working group. Records for Guy’s Hospital exist for the period before 1813, but they do not include any reasons for admission and were therefore excluded.

When arrayed chronologically, data are available for eight consecutive decades of the long eighteenth century, from 1760 to 1840. Admission and discharge records are available for four of the general hospitals during this period: the Royal London, Middlesex, St. Thomas’, and Guy’s. Reasons for admission that indicate an individual had a “fracture” or a “broken” body element were recorded as fractures, while elements that were recorded as “bruised,” “hurt,” or “injured” were not. It is possible that an individual may have been admitted to hospital with an injury that appeared bruised or lacerated but was actually a fracture; therefore, the fracture prevalence recorded likely underestimates the number of fractures treated in the voluntary hospitals.

The hospital admissions do not record which side a fractured element came from or where upon the bone the fracture was found. This fact complicates the possible comparisons to be made with the skeletal data. The skeletal data were, therefore, statistically tested to determine if there were significant differences between the left and right sided elements. When there was no significant difference, the sided data were pooled and the combined data were compared to the hospital admission record results. The few circumstances in which there were significant differences are described in Appendix A (Tables A.7, A.9).

When examining historical hospital records and physicians' diagnoses, it is necessary to have an understanding of contemporary nosology. Eighteenth-century physicians conceived of disease diagnoses as a form of taxonomy including classes, orders, genera, and species, following the example of botanists (King, 1958). The three authors whose texts had the greatest effect on the nosological framework of the eighteenth century were Carl von Linné (1763), François Boissier de Sauvages (1731, 1768), and William Cullen (1792), who sought to classify diseases based upon symptomological signs (understood at the time to include perceptible lesions and bodily changes), autopsy results, and theory. The results were often confusing and unnecessarily complex; Sauvages, for example, identified seventeen different varieties of cough (King, 1958). Fractures were classified under the order "Plagae," which also included contusions, fissures, ruptures, and amputations, and defined fractures as the violent and mechanical separation of bones into fragments (Sauvages, 1768, p. 239). Cullen divided disease into four classes, Pyrexias (e.g., fevers, local inflammations including catarrh and types of dysentery), Neuroses (nervous ailments e.g., apoplexy, convulsions), Cachexias (e.g., emaciations, swellings, discolourations including scrofula, syphilis, and scurvy), and Locales (collection of eight orders describing other conditions that could not otherwise be categorized (e.g., hernia, loss of appetite, cancer) (King, 1958). Fractures, according to Cullen, fell under the order Locales and were defined as "bones broken into large fragments" (1792, p. 80).

3.3.2 Assessing dataset quality

Michael Drake's work concerning parish records sets out an algorithm for examining the quality and reliability of the data found in vital records to aid the researcher in deciding which records to consult (1982, p. vii). I adapted aspects of Drake's method to investigate the hospital admission and discharge records. According to Drake, first one should determine if the register has at least 100 entries a year. All of the hospital admission records used in the current research meet this requirement.

Second, one should examine if there are any obvious gaps; essentially, do the missing years make up less than 10% of all the years under investigation? The Middlesex Hospital records are available for 23 years, versus the Royal London's 3.5 years. As outlined in Table 3.4, St. Thomas' has extant records from 1774 – 1800, with a variety of gaps. Guy's Hospital has continuous records available from 1813 – 1838. As Drake notes, the algorithm is a guideline to help the researcher determine how best to use his or her time and how one deals with gaps depends upon "the aims of the enquiry" (1982, p. x). I sought to consult all extant hospital records, thus the gaps in the records were not a deterrent.

Third, one must determine if there is evidence of under registration in the records. This aspect of Drake's algorithm is the most important for this research and helps determine how the records for each hospital are used in this investigation. Most of the reasons Drake suggests for possible under registration in the parish records, such as breaks in registration due to changes in the boundaries of parishes and the delaying of recording vital events such as baptisms, have no relevance to hospital admission records.

Drake does, however, note that the change of the registrar may affect the quality of the data recording. In the documents consulted for this research, it appears as though one individual at each hospital was tasked with recording the admission and discharge of patients for a period of many years. Errors that may be introduced to admission registers during copying (Hollingsworth, 1969, p. 299) are always a possibility. Amendments to the admission records were found in several cases, suggesting that the records under study were the originals rather than copies. Under registration is related to the administrative system of each hospital and the records vary in detail accordingly.

Each hospital recorded a different array of data in the admission and discharge records. The Royal London Hospital records have the richest set of data: the records note the name, date of admittance, place of abode, occupation, age, reason for admission, and result of hospital stay for each individual. These records come the closest to what Clifton (1731) recommended. The Middlesex Hospital records only note the name, date of admission, and reason for admission. Unlike the records for Guy's and St. Thomas', the Middlesex Hospital apothecary reports list a reason for admission for each individual admitted to the hospital. The records for Guy's only include individuals' ages from 28 November 1832 to 26 December 1838, while the St. Thomas' records address age simply by noting that certain admitted individuals are children. The Guy's and St. Thomas' records provide information on individuals' names and dates of admission, but only record the reason for admission for a select few individuals per admission period. This means that any conclusions drawn concerning the admissions to these institutions are based upon a small proportion of the total admissions (see Table 3.6). For instance, on

April 27, 1814 there were 46 patients (25 males and 21 females) admitted to Guy's Hospital. Of those 46 patients, reasons for admission were recorded for only four individuals. The fracture prevalence results for St. Thomas' and Guy's Hospitals will therefore underestimate the overall admittance of fractures into these establishments. Of the 99,332 individuals admitted to St. Thomas' and Guy's Hospitals during the period under study, reasons for admission were recorded for 19,200 individuals, or 19.3%. The records for Guy's and St. Thomas' hospitals certainly show evidence of what Drake terms under registration. These records display the reason for admission for only between 13.6% and 25.3% of the individuals admitted to the hospitals per decade. These records will, therefore, be used as ancillary evidence to explore both the skeletal evidence for fractures and the fracture careers of individuals admitted to the Middlesex and the Royal London hospitals.

Table 3.6 – Array of completeness of hospital admission data

Decade	Hospitals	Admitted with reason recorded	Percentage of admissions with reasons	Total admitted
1760-1769	Middlesex	1450	99.8%	1453
	Royal London	1310	99.9%	1311
1770-1779	St. Thomas'	357	14.5%	2460
	Middlesex	2653	99.7%	2660
1780-1789	St. Thomas'	1679	14.8%	11372
	Middlesex	2100	99.6%	2108
1790-1799	St. Thomas'	1750	15.2%	11543
	Royal London	1816	95.8%	1896
1800-1809	St. Thomas'	343	14.0%	2455
	Royal London	470	94.8%	496
1810-1819	Guy's	2327	13.6%	17073
1820-1829	Guy's	5714	21.4%	26678
1830-1839	Guy's	7030	25.3%	27751

While the records for the Royal London list the result of each individual's hospital stay in the same row as the admission information, Guy's, St. Thomas', and the Middlesex do not. In order to determine the fate of each individual entering the hospital with a fracture, it was necessary to track the names of these individuals and look for them in the discharge records. Each hospital had weekly lists of individuals discharged. Lists of individuals with fractures were compiled as they were discovered in the admission papers and these names were individually cross-referenced with the names found in the discharge lists. In this time-consuming manner, I attempted to determine the fate of each individual with a fracture. I created a database of all individuals admitted to the hospitals for fractures. This allowed me to search common names (such as John Smith) to determine if these individuals were admitted to hospital around the same time (suggesting that the admissions likely represented two different individuals) or if one John Smith was admitted after another John Smith had been discharged, raising the possibility that it was the same individual readmitted to the same hospital. Evidence of individuals being readmitted to hospital for the same injury was also investigated in this manner.

The discharge records revealed a variety of fates. Individuals may be: (1) discharged from the hospitals, (2) made outpatients (this information is only consistently available for the Middlesex Hospital), or (3) become lost to observation (due to death, self-discharge, or because the discharge records were missing). Being discharged did not necessarily equate with a patient being cured. Patients were discharged for a variety of noted reasons including being “cured,” being “relieved,” leaving by their own desire, or being forcibly discharged for irregular behaviour.

3.3.3 Methods

3.3.3.1 Determining sex

Sex of the individuals admitted to the general hospitals was determined through examination of given names. The Royal London and Middlesex admissions were recorded in a chronological list for each week, not by sex. The Guy’s and St. Thomas’ admission lists were generally organized into male and female lists, but the list of names for which reasons for admission were recorded were often not organized into groups differentiated by sex. Since the majority of the records were not divided into male and female groups, it was necessary to assign sex from the individual’s given name. Most sex assignments were simple. The majority of individuals had common given names such as William, John, James, Robert, Thomas, Mary, Elizabeth, Sarah, Ann, and Margaret. The range of names included many Biblical characters, such as males Joshua, Isaac, Solomon, Ezekiel, and females Hannah, Martha, Rebekah, and Kezziah. The records also included many names that have fallen out of wider popularity today, such as Crumpton, Cadwallider, Fenwick, and Pompey for males, Typhena, Mirabilis, Lettice, and Blandina for females. In the case of the Royal London records, additional clues were provided under the occupation column, since many women were recorded as being a "Sailors Wife," "Labourers Wife," or a "Washerwoman." Individuals whose given names were recorded only as a first initial were assigned a sex if they were included in a sex-based list of names. In the instances (n = 84) where sex estimation was not possible, the individuals were removed from the final sample group.

3.3.3.2 Legibility concerns

Legibility of the records was, for the most part, not an issue in this investigation. Once I had successfully 'decoded' the handwriting, it was not difficult to understand what was written, particularly because a single author appeared to be responsible for the registers for a period of multiple years, many names were repeated, and the words 'fracture' and 'broken' proved easy to pick out. The greatest challenge in legibility came with studying the admission records for St. Thomas' between 12 December 1793 and 15 October 1795. These records have been deemed unfit for consultation by the London Metropolitan Archives due to their fragility. Digital scans are available as part of the

London Lives project, but the quality of the scans is variable. The light handwriting, torn edges of the paper, and the effect of scanning mean that some pages were nearly impossible to read. I printed out the pages that proved most difficult to decipher on the computer monitor and traced the markings I could make out with the aid of a hand lens. With this method I was able to read most of what was present, but there remains the possibility that select individuals in the discharge lists were lost to observation due to difficulties with viewing the documents (Appendix C – Tables C.2, C.3).

3.3.3.3 Diagnosis of fracture

Physicians and surgeons working during the "long" eighteenth century were operating under a nosological system that defined fractures as bones forcibly divided into segments. This definition is similar to both current clinical and palaeopathological definitions of fracture, suggesting that fractures are reasons for hospital admission that transcend time more easily than, for example, diagnoses of "foul" diseases that may encompass many venereal complaints or conditions that are unfamiliar to modern eyes, such as St. Vitus's Dance. Medical students during the eighteenth century were certainly exposed to education concerning fractures. A surgical student at St. Thomas' Hospital recorded in his notebook, covering the years 1725 and 1726, detailed descriptions of the causes and treatments of cranial, femoral, tibial, and fibular fractures (KCL, GB 0100 TH/PP44). An indirect source of evidence suggesting that physicians and surgeons at the voluntary hospitals would be well-versed in the appearance of fractures are the pathological collections at institutions such as St. Bartholomew's and Westminster hospitals and the Royal College of Surgeons. The Westminster Hospital pathology collection, which had its roots in the eighteenth century, by the nineteenth century was 38.8% comprised of fracture specimens (19/49 total specimens) (Mitchell & Chauhan, 2012, p. 143). Mitchell & Chauhan (2012) posit that the proportion of specimens representing fractures may be so high because curators thought they were particularly important, or perhaps fractures were among the most common conditions affecting bone at the time. Another possibility is that fractures were relatively simple to observe and identify in living patients (Mitchell & Chauhan, 2012). Almost exactly half of the Royal College of Surgeons anatomy and pathology collection (pre-1886) were fracture specimens (1016/2036 = 49.9%). The St. Bartholomew's Anatomical Museum descriptive catalogue (1846) includes over 200 descriptions of fracture specimens, ranging from minor metacarpal fractures to dramatic long bone and skull fractures. Many specimens are healed antemortem fractures, and include patient histories, such as a male individual who suffered a midshaft humeral fracture four years antemortem. He was "so little impaired by the fracture that [he] worked as a sailor to the time of his death" (1846, p. 116). These sources of evidence suggest that fractures were a relatively common sight in medical education and that a diagnosis of "fracture" or "broken" recorded in the hospital admission records accurately refers to a broken bone.

There are limitations to both historical and contemporary clinical reports concerning fracture frequencies; primarily, individuals admitted to hospital are self-selecting (e.g., Court-Brown & Caesar, 2006; Koval & Cooley, 2006; Lane, 2001). There have been valiant attempts to quantify the commonness of different fractures (e.g., Buhr

& Cooke, 1959; Court-Brown & Caesar, 2006; Singer, McLauchlan, Robinson, & Christie, 1998), but ultimately the data depend upon individuals choosing to seek medical attention. In addition, data are derived from particular hospitals, ensuring that the results are geographically specific (e.g., Donaldson, Cook & Thomson, 1990; Johansen et al., 1997; Sahlin, 1990; van Staa, Dennison, Leufkens, & Cooper, 2001). The same was true in London during the "long" eighteenth century. Admission was complicated by a variety of factors unfamiliar to a modern observer, such as official admission being allowed only once a week in certain institutions, and the necessity of campaigning for a hospital governor's permission for admittance (Barry & Carruthers, 2005; Dainton, 1961; Lane, 2001; Lawrence, 1996; Woodward, 1974).

The efforts to keep accurate records as annual admissions rose was clearly a challenge for hospital clerks. Risse (1986) describes a series of errors discovered in the eighteenth-century Edinburgh infirmary records, such as admission papers being lost for 40 patients in 1775 who were, therefore, never entered into the register (p. 49) or male admissions being listed with exclusively female diagnoses. Human error certainly has a role in the admission records consulted for this research. Totaled weekly admissions for Guy's and St. Thomas' were written at the base of most admission and discharge pages and, in 102 instances, were incorrect due to addition errors. These addition errors then carried over to the annual totals. I counted all admissions individually to ensure that I was not compounding past errors into my own work. Children of inpatients were inconsistently recorded in the number of admitted inpatients; I separated these children out of the totals to access the total number of admitted adults only.

3.3.3.4 Anatomical groupings

In order to facilitate meaningful comparison with the skeletal results, the body was divided into anatomical groups similar to those outlined in section 3.2.5.5 for the skeletal dataset. The cranial group included fractures to the skull/head, nose, face, maxilla, and mandible/jaw. The torso group included the sternum, ribs, and spine/back. The arm group included the shoulder girdle (scapula/shoulder, clavicle) and bones of the arm (arm, humerus, radius, ulna/olecranon). The leg category included the hip, thigh/femur, leg, knee/patella, tibia, and fibula. The hand group included the hand, wrist, finger, and thumb, while the foot group included the foot, ankle, toe, and calcaneus.

3.3.3.5 Determining length of stay in hospital

The length of stay in hospital for individuals from Guy's, St. Thomas', and the Middlesex was determined by tracking individual patients through their admission and eventual discharge by keeping a running list of individuals who were admitted for a fracture and cross-referencing the names to individuals being discharged. Records for the Royal London Hospital list a patient's date of admission and discharge in the same ledger, as well as a fate of "cured" or "died." Those individuals who died were removed from this sample. In the creation of Table C.13, any individuals who were listed in the discharge records on two different dates were removed to lower the probability that the wrong individual was being identified in the discharge records. The closed and compound fractures (Table C.14) were considered separately because compound fractures are considerably more complicated and dangerous than closed fractures and generally required longer hospital stays.

3.3.3.6 Identifying individuals who suffered multiple fractures

Hospital records are not linked with individual identification numbers or other unique identifiers. Recording all names of individuals admitted for fracture and noting when the same name appeared on more than one admittance day identified the individuals who may have suffered multiple fractures. Cases wherein individuals with the same name were admitted to a hospital at the same time were included when it could be determined that they were two separate people. For example, James Chambers was admitted to Guy's with a fractured leg on 30 January 1831 (left 16 March 1831). Another individual named James Chambers was also admitted to Guy's for a fractured leg; this individual was admitted 14 February 1831 and left 25 May 1831. These overlapping periods suggest that the records are referring to two different people.

Individuals who could potentially have suffered multiple fractures or several fracture incidents to the same element were separated into two groups. The first group comprises instances where the same name appears more than once, but is associated with differing injuries. The second group includes cases where individuals appear to enter hospital, be discharged, and then re-enter the same hospital with the same fractured element within a few days to a year.

3.3.3.7 Identifying occupations

The Royal London Hospital admission register includes information on individuals' self-reported occupation. The occupational categories are adapted from Risse (1986, p. 88). Risse (1986) includes all labourers as agricultural workers. This is too great a generalization of what the term "labourer" could mean during the "long" eighteenth century, particularly in an increasingly industrialized city like London, thus the labourers have been set aside in their own category.

3.3.3.8 Statistical Methodologies

True prevalence was calculated for all affected skeletal elements, following the formula: n/N x 100, where n is the number of affected elements and N is the number of total elements. Chi-square tests (Fletcher & Lock, 2005, pp. 129-132), all at $p < 0.05$, were employed to determine if there were statistically significant differences between male and female groups or between the hospital and non-hospital skeletal samples in the observed proportions of fractured elements. In most cases the individual or element counts were more than five, making it appropriate to use the Chi-square test. Where the cell counts were fewer than five, the Fisher's exact test was conducted. Differences between two proportions (Fletcher & Lock, 2005, pp. 98-100) were conducted upon categorical fracture data from the skeletal and hospital admissions datasets in order to compare them. Spearman's rank correlation (Fletcher & Lock, 2005, pp. 123-126) was employed to investigate if there was a relationship between the male and female groups' most frequently fractured elements when the categories were ranked. Statistical calculations were made using Graph Pad QuickCalcs (http://www.graphpad.com/quickcalcs/) and the Social Science Statistics online calculators (http://www.socscistatistics.com/).

3.3.4 Considerations and limitations of archival datasets

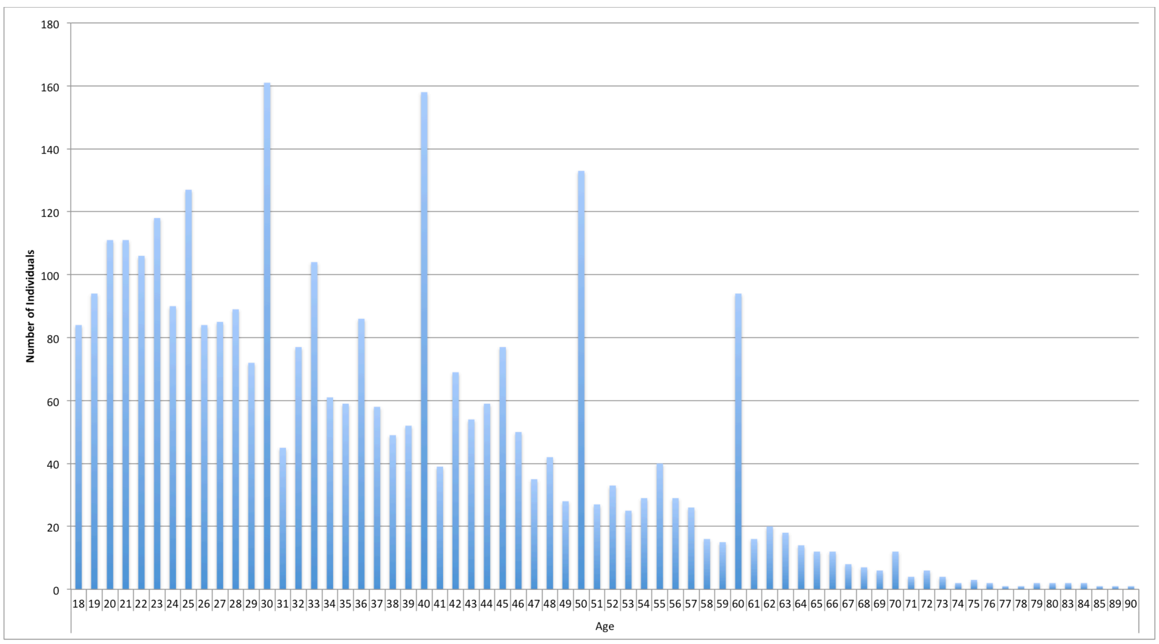
The competency of the creators of documents in the archives must be considered. Various authors have characterized the historian or user of the archives as a detective (e.g., Ginzburg, 1989; Winks, 1969), emphasizing that the "probative value of evidence in a particular setting" (Turkel, 2006, p. 260) must be considered. The largest limitation in consulting archival records, as discussed above, is that the data collected are limited to which records have survived and are available for study.

This investigation is focused on individuals 18 years of age and older and thus it was necessary to identify and exclude juvenile individuals (17 years of age and younger) present in the admission records. The differentiation between children and adults is a social categorization that has changed through time to evolve into contemporary conceptions of childhood (Ariès, 1962; Shahar, 1993). Children do not make up a large proportion of those admitted to the general hospitals. Most entered the records when their mothers were admitted to hospital and were thus not counted in the total admitted to hospital. The Middlesex admitted a small number of children, but noted their age or youth in each case; for example "Jno [John] an infant" was admitted to the Middlesex on 23 April 1760 with a fractured thigh and later (no date recorded) made an outpatient. The Royal London Hospital appears to have allowed more children to be admitted than the other hospitals. Thankfully, the Royal London records include the age of admitted individuals and thus exclusion was relatively straightforward. In the Guy's and St. Thomas' records, where ages were not regularly recorded, all individuals noted as "infant" or "child" were removed from the final sample and all remaining individuals were assumed to be adults. It is possible that some juvenile individuals made it into the final sample because the hospital clerks responsible for the admissions registers did not identify them as children.

The limitation of age heaping must be considered when examining archival records. This problem occurs when chronological ages are rounded up or down to the nearest five or ten years, usually due to individuals not knowing their exact age (Chamberlain, 2006). Nolan (1998) reported this problem in the burial registries of the Newcastle Infirmary, where the number of individuals with the reported age of 30, 40, 45, 50, 55, and 60 is high, while ages such as 31 and 41 have far lower numbers of individuals.

Age heaping is clearly at play in the archival records for the Royal London Hospital. Figure 3.2 displays the range of ages present in the Royal London admission register. There is clear heaping at ages 30, 40, 50, and 60 with smaller peaks at age 25, 45, and 55. Whipple's index (Siegel & Swanson, 2004) was calculated for this sample and found to be 167.9 for the male sample and 167.3 for the females. Whipple's index is a summary index calculated by taking the sum of the number of individuals reporting their age as 25, 30, 35, 40, 45, 50, 55, and 60, multiplying this total by 5, dividing the result by the number of individuals in the age categories 23 to 62 inclusive and multiplying the result by 100. An index below 105 indicates that the dataset is highly accurate, between 105-110 the data are relatively accurate, 110-125 the data are approximate, 125-175 the data are poor, and 175+ the data are very poor (United Nations, 1955; Newell, 1988). These results indicate that there is a substantial inaccuracy in the reporting of ages.

Figure 3.2 – Age array of Royal London Hospital archival sample



Ensuring that terms are clearly defined will aid in the comparative use of skeletal and documentary data (e.g., Howell, 1986; Petersen, 1975), a caveat most applicable to social age categories. Other examples are more culturally defined, such as cause of death as recorded in burial records, which must be analyzed with caution. The assigned cause of death is based upon the physician's knowledge of the patient, but also reflects the prevailing medical philosophy of the time (Sartwell & Last, 1980); medical practitioners may assign cause of death disproportionately as their favourite disease (Hollingsworth, 1969, p. 220). Guenter Risse (1986) refers to physicians' diagnoses as diagnostic labels, or reasons for admission/death as medical practitioners understood them at the time. Further, causes of death are often ambiguous such as "drinking cold water" or "mortification" (Higgins & Sirianni, 1995, p. 123). Terms such as dying of "old age," being "aged," or "decay" are likely to be similar to contemporary understandings of dying of old age (Scheuer & Bowman, 1995, p. 62). In the St. Bride's Fleet Street crypt skeletal sample some individuals are identified as having died of cancer, though all individuals with this label were women, suggesting this may refer specifically to breast cancer (Scheuer & Bowman, 1995). In special cases the cause of death may be vague on purpose to allow an individual to have a Christian burial; an individual who had committed suicide by gunshot was recorded as having been "suddenly found dead" in St. Bride's Fleet Street church records (Bowman, MacLaughlin, & Scheuer, 1992, p. 93). Issues with diagnosis mean that there is little comparable historical data, particularly in reference to infectious diseases.

Rosenberg and Golden (1992) and Cunningham (2002) among others (e.g., Arrizabalaga, 2002; Hays, 2007; Metcalfe, 2007; Mitchell, 2011) discuss the complex nature of studying disease in the past; one must consider the modern biological diagnosis and the social diagnosis used by individuals in the past. Information gleaned from surgeons' casebooks and catalogues of contemporary anatomical collections suggests that surgeons had a robust comprehension of fracture causes and treatments that is comparable to modern understandings.

3.4 BASELINE SAMPLE

Table 3.7 Total number of individuals excluded from study sample

Source	< 18 years	Indeterminate sex
Middlesex	6	67
Royal London	470	2
St. Thomas'	37	2
Guy's	1394	13
Total	**1907**	**84**

Table 3.7 displays the number of individuals that were removed from the archival study sample. 1907 individuals were removed because it was determined that they were younger than 18 years old and 84 individuals were removed because it proved impossible to assign them a sex. Table 3.8 displays the total number of individuals in the final study sample for both the skeletal collections and hospital record collections divided by sex.

Table 3.8 Total number of individuals in study sample

Source	Males	Females
Skeletal Collections		
St. Bride's lower churchyard	190	125
Payne Road/Bow Baptist	83	110
Cross Bones	12	27
Royal London Hospital	80	30
St. Thomas' Hospital	37	27
Total Skeletons	**402**	**319**
Hospital Record Collections		
Middlesex	4362	1854
Royal London Hospital	2285	1418
Guy's Hospital	40,839	30,664
St. Thomas' Hospital	18,727	9103
Total Hospital Admissions	**66,213**	**43,039**

3.5 SUMMARY

Through the observation of 721 adult skeletons of individuals who lived and died during the “long” eighteenth century and the consultation of contemporary hospital admissions records, it is possible to gain insights into the fracture experience of the working poor in London. The data gathered from the skeletal and archival collections outlined above forms the baseline sample for the data analyses and discussion to follow. The skeletal dataset allows for an analysis of fracture patterning in individual bodies and the overall sample prevalence. The hospital admissions dataset provides the basis for analyses of average length of stay in hospital for each fracture type divided by sex. The additional detail available in hospital petitions, case histories, and surgeons’ notebooks allow for the possible clinical presentation of fractures discovered in the skeletal remains to be described and placed into their medical context.

CHAPTER 4.0 – RESULTS and DISCUSSION: Evidence for Fractures in the Skeletal and Archival Datasets

4.1 INTRODUCTION

In this chapter I outline the age distribution of individuals in the skeletal and admission record study samples. I report the frequency of antemortem and perimortem fractures observed in the five cemetery sites investigated. I also discuss the frequency of individuals admitted to the Royal London and Middlesex Hospitals for fracture. I compare the skeletal and admission record datasets for the anatomical distribution of fractures in six categories: fractures to the cranium, torso, arm, hand, leg, and foot. The skeletal and admission record datasets are compared, revealing differing distributions of observed and admitted fractures.

4.2 EVIDENCE OF FRACTURES IN SKELETONS AND RECORDS

4.2.1 Overall summary

Table 4.1 Total number of individuals in each sex category

Site	Male	Female	Total
St. Bride's lower churchyard	190	125	315
Payne Road and Bow Baptist	83	110	193
Cross Bones	12	27	39
Royal London Hospital	80	30	110
St. Thomas' Hospital	37	27	64
Total	**402**	**319**	**721**

Table 4.1 shows that the total skeletal sample group comprises 721 individuals of known sex.

The total adult sample included more males (402) than females (319). The aim was to include as many adults as possible for the largest possible skeletal sample. There was no deliberate selection of individuals by age or sex. The difference in numbers between the males and females (Table 4.1) was statistically significant (χ^2 6.38, $p < 0.05$). Therefore, sex-specific trends must be considered with caution, acknowledging the potential for bias.

Figure 4.1 displays the age distribution of the total sexed skeletal sample. Males have higher numbers of individuals in all age categories, except MA1 (26-35 years), where the number of males and females is equal. Data presented in Figure 4.1 indicate that the skeletal sample is weighted toward middle and older adults.

Figure 4.1 Age distribution of the total sexed skeletal sample

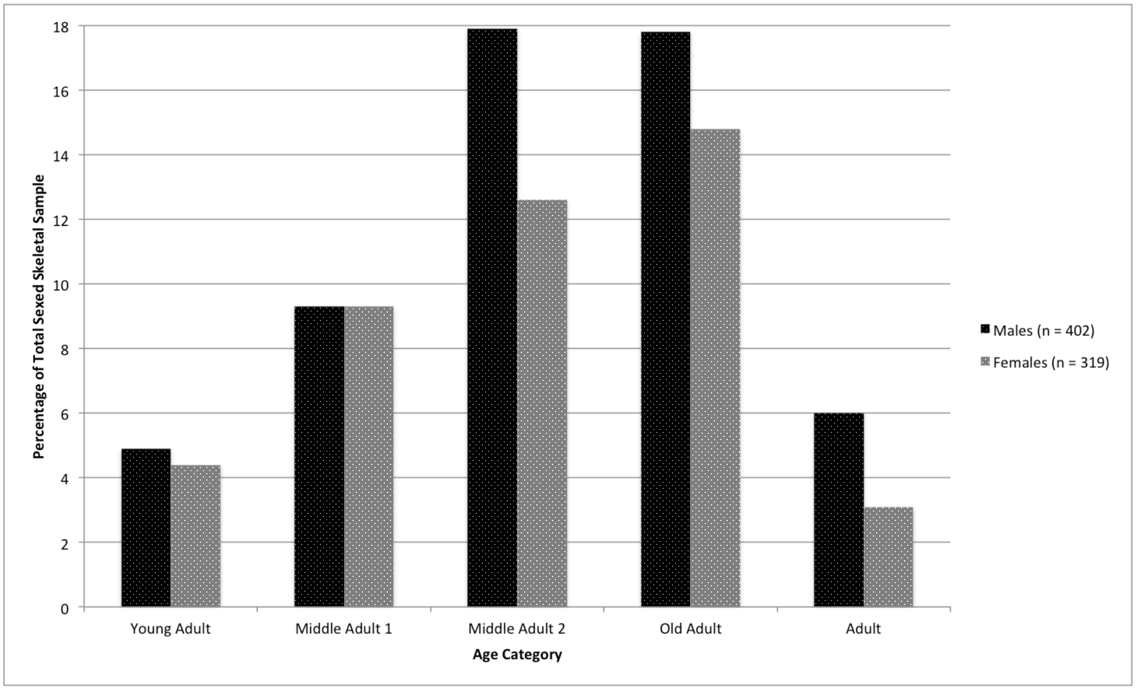


Table 4.2 displays the sex and age distribution of the total skeletal sample, divided into the hospital and non-hospital (parochial/church cemetery) skeletal samples. These data are displayed visually in Figures 4.2 and 4.3.

Table 4.2 – Sex and age distribution of total skeletal sample

	Males						Females					
Site Name	YA*	MA1	MA2	OA	AM	Total	YA	MA1	MA2	OA	AF	Tota
NLB91	10 (27.0)	6 (16.2)	14 (37.8)	6 (16.2)	1 (2.7)	37	9 (33.3)	4 (14.8)	8 (29.6)	4 (14.8)	2 (7.4)	2
RLP05	8 (10.0)	23 (28.8)	27 (33.6)	9 (11.3)	13 (16.3)	80	5 (16.7)	10 (33.3)	9 (30.0)	3 (10.0)	3 (10.0)	3
Hospital Total	**18 (15.4)**	**29 (24.8)**	41 (35.0)	15 (12.8)	14 (12.0)	117	**14 (24.6)**	14 (24.6)	17 (29.8)	7 (12.3)	5 (8.8)	5
REW92	2 (16.7)	1 (8.3)	6 (50.0)	1 (8.3)	2 (16.7)	12	1 (3.7)	2 (7.4)	11 (40.7)	12 (44.4)	1 (3.7)	2
PAY05/BBP07	10 (12.0)	16 (19.3)	29 (34.9)	24 (28.9)	4 (4.8)	83	13 (11.8)	30 (27.3)	33 (30.0)	24 (21.8)	10 (9.1)	11
FAO90	5 (2.6)	21 (11.1)	53 (27.9)	88 (46.3)	23 (12.1)	190	4 (3.2)	21 (16.8)	30 (24.0)	64 (51.2)	6 (4.8)	12
Parish/Church Total	17 (6.0)	38 (13.3)	88 (30.9)	**113 (39.6)**	29 (10.2)	285	18 (6.9)	53 (20.2)	74 (28.2)	**100 (38.2)**	17 (6.5)	26
Overall Total	35	67	129	128	43	402	32	67	91	107	22	31

* YA = young adult (18-25); MA1 = middle adult 1 (26-35); MA2 = middle adult 2 (36-45); OA = old adult (46+); AM = adult male; AF = adult female. Each cell contains the number of individuals from the skeletal collection in each age category. Numbers in parentheses represent the number of individuals in the age category out of the total number of individuals from each skeletal collection. Shaded cells display pooled hospital and parochial/church datasets. The bolded results were statistically significant ($p < 0.05$).

When the age-sex distributions of the hospital and parochial/church skeletal samples were compared, it was revealed that the hospital sample has a significantly ($p < 0.05$) higher proportion of young adult males, young adult females, and MA1 males. The parochial/church group has a significantly ($p < 0.05$) higher proportion of old adult males and old adult females.

Figure 4.2 Age categories of individuals from hospital cemeteries sample

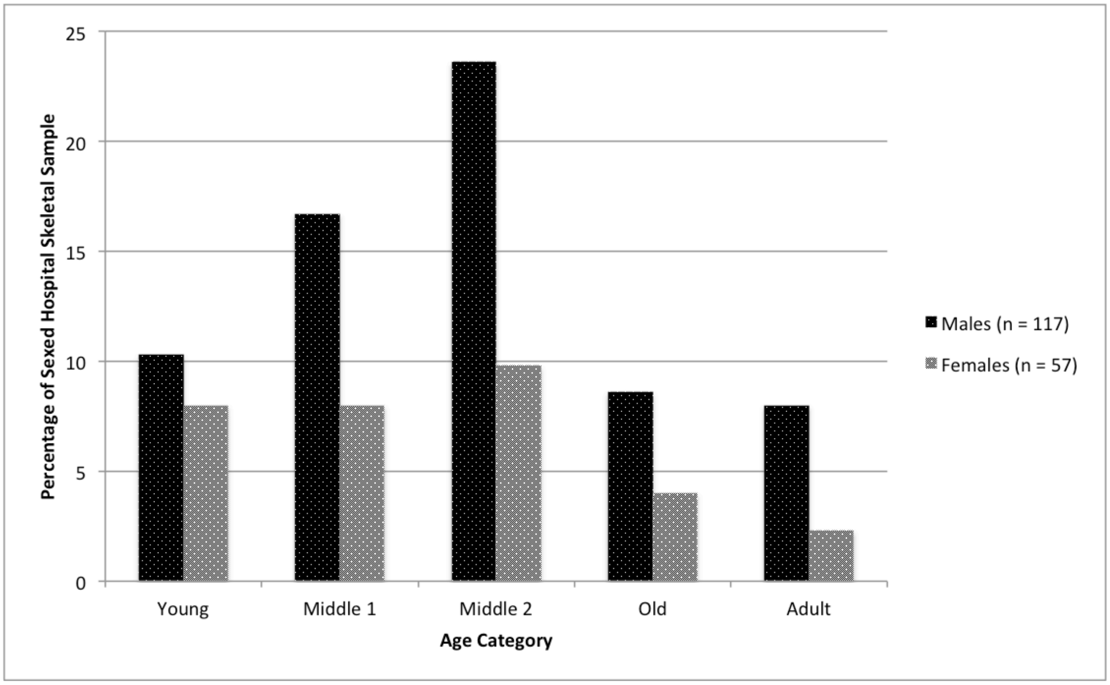


Figure 4.3 Age categories of parish and church cemeteries sample

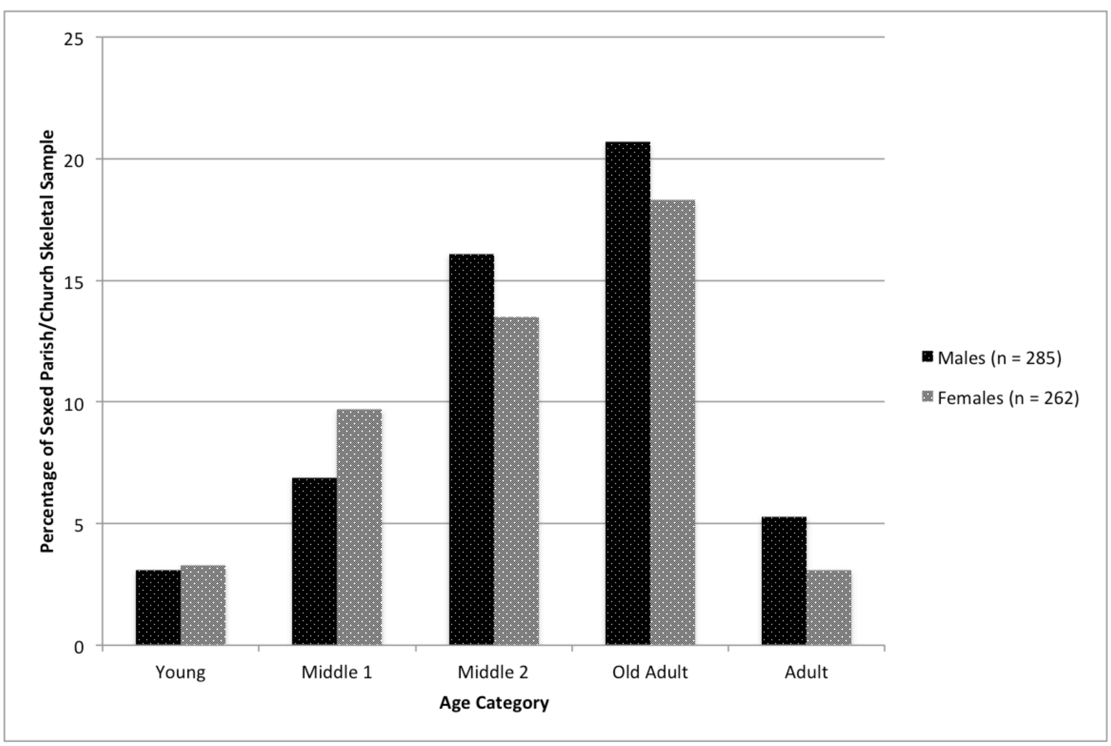


Figure 4.2 demonstrates that males in the MA2 category (35-45 years) make up the largest proportion (41/174 = 23.6%) of the hospital skeletal sample. There are more males than females in each age category, a typical finding for archaeological skeletal collections (Weiss, 1972). It is possible that some older, possibly post-menopausal female individuals have been identified as male (Walker, 1995). Figure 4.3 shows the distribution of ages present in the parochial and church cemeteries skeletal sample. More females than males were present in the YA and MA1 categories, while the males outnumbered the females in the MA2 and OA age categories.

The results displayed in Figure 4.2 may be reflecting what Wood et al. (2002) termed the "accident hump" (pp. 138-139), the peak in male mortality seen in historical populations and contemporary society in males between the ages of 20 to 50 years. The significantly higher proportion of male individuals in the young adult and MA1 age categories in the hospital sample suggest that there were behavioural factors affecting male individuals in these age groups that caused them to die in hospital. This increased risk of death for males is explained as the result of risk-taking behavior and the adoption of adult masculine behaviour (Courtenay, 2002, 2003; Sabo, 2004; Stillion, 1995). Pollard and Hyatt (1999) note that in the clinical sciences there is an observed lower life expectancy for males from conception onward. Clinical data have demonstrated that the majority of individuals who die between the ages of 15 and 24 are male (Courtenay, 2003). Limitations of skeletal aging techniques may, however, cause an apparent peak in mortality in the young and middle adult years (Chamberlain, 2000; Kemkes-Grottenthaler, 2002) and this is one possible explanation for the higher number of male individuals in the middle-adult age categories found in the hospitals skeletal sample. The parish and church skeletal sample displays a more attritional demographic profile than the hospital sample, where males outnumber females in every age category. It is also possible that more females than males are present in the YA and MA1 age categories due to risks associated with childbirth.

4.2.2 Skeletal evidence of fracture

Fractures were separated into perimortem and antemortem categories. The crude prevalence of sexed individuals affected by one or more antemortem fractures is displayed in Table 4.3 (a full summary of all fractures is available in Appendix B). The crude prevalence of sexed individuals affected by perimortem fractures is displayed in Table 4.4. The final study sample contains 721 adult individuals from five cemetery sites in London. Of those, 265 individuals (188 males and 77 females) displayed evidence of one or more antemortem fractures, for a crude prevalence of 36.8%. Three individuals (two males and one female) displayed evidence of perimortem fractures, for a crude prevalence of 0.4%. The age distribution of all individuals in the skeletal sample with fractures is displayed in Figure 4.4.

Figure 4.4 – Age distribution of individuals with fractures in total skeletal sample by sex

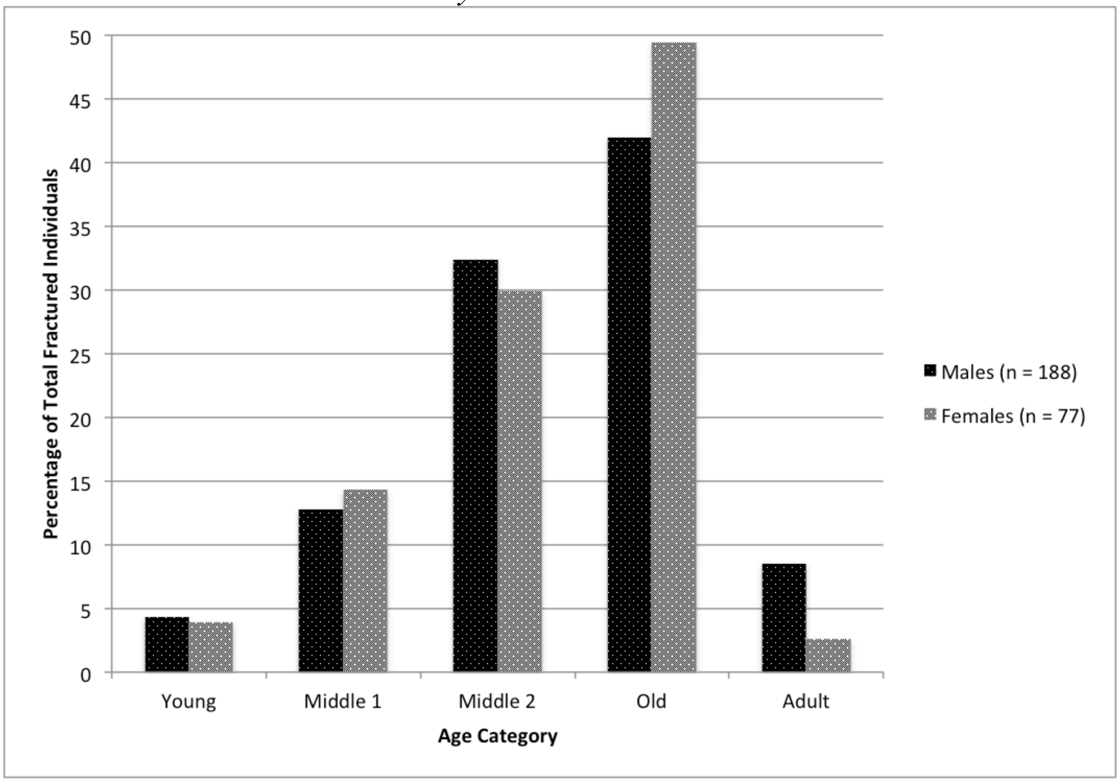


Table 4.3 Proportion of male and female individuals with antemortem fractures

Site Name and Type		Male Individuals with Fractures	Female Individuals with Fractures	Total Individuals
Hospitals	NLB91	11/37 (29.7%)	4/27 (14.8%)	15/64 (23.4%)
	RLP05	47/80 (58.8%)	9/30 (30.0%)	56/110 (50.9%)
Hospitals Total		58/117 (49.6%)	13/57 (22.8%)	71/174 (40.8%)
Parish/Church	REW92	7/12 (58.3%)	6/27 (22.2%)	13/39 (33.3%)
	PAY05/BBP07	35/83 (42.2%)	20/110 (18.2%)	55/193 (28.5%)
	FAO90	88/190 (46.3%)	38/125 (30.4%)	126/315 (40.0%)
Parish/Church Total		130/285 (45.6%)	64/262 (24.4%)	194/547 (35.5%)
Overall Total		**188/402 (46.8%)**	**77/319 (24.1%)**	**265/721 (35.8%)**

Each cell displays the number of individuals with antemortem fractures out of the total number of individuals of each sex from each skeletal collection. Shaded cells display the pooled data for the hospital and parish/church skeletal collections.

Chi-square tests of the data in Table 4.3 revealed a statistically significant higher crude prevalence of fractures in males within both the hospital (χ^2 = 11.368, p < 0.001, 1 df) and parish groups (χ^2= 26.772, p < 0.0001, 1 df). There was no significant difference between the hospital and parish/church groups when compared by sex.

Table 4.4 Proportion of male and female individuals with perimortem fractures

Site Name and Type		Male Individuals with Fractures	Female Individuals with Fractures	Total Individuals
Hospitals	NLB91	0/37 (0%)	0/27 (0%)	0/64 (0%)
	RLP05	2/80 (2.5%)	1/30 (3.3%)	3/110 (2.7%)
Hospitals Total		2/117 (1.7%)	1/57 (1.8%)	3/174 (1.7%)
Parish/Church	REW92	0/12 (0%)	0/27 (0%)	0/39 (0%)
	PAY05/BBP07	0/83 (0%)	0/110 (0%)	0/193 (0%)
	FAO90	0/190 (0%)	0/125 (0%)	0/315 (0%)
Parish/Church Total		0/285 (0%)	0/262 (0%)	0/547 (0%)
Overall Total		**2/402 (0.5%)**	**1/319 (0.3%)**	**3/721 (0.4%)**

Each cell displays the number of individuals with perimortem fractures out of the total number of individuals of each sex from each skeletal collection. Shaded cells display the pooled data for the hospital and parish/church skeletal collections.

The Fisher's exact test was conducted upon the data in Table 4.4. The difference between the hospital and parish/church crude prevalence for perimortem fractures is not significant for either males or females.

Tables 4.5 and 4.6 display the Fisher's exact and Chi-square statistics for comparisons between the overall male and female skeletal samples in regards to antemortem and perimortem fractures.

Table 4.5 Comparison of males and females with antemortem fractures

	Fractured	Not fractured	Total
Male	188	214	402
Female	77	242	319
Total	265	456	721

Chi-square: 39.178. P value is < 0.0001. Significant at $p < 0.05$.

Table 4.5 shows that in the pooled skeletal sample the males have a significantly higher number of antemortem fractures than the females.

Table 4.6 Comparison of number of males and females with perimortem fractures

	Fractured	Not fractured	Total
Male	2 (66.7)	400 (55.7)	402 (55.8)
Female	1 (33.3)	318 (44.3)	319 (44.2)
Total	3	718	721

Fisher exact test statistic: 1. Not significant at $p < 0.05$.

Table 4.6 shows that no statistically significant differences in prevalence of perimortem fractures by sex were discovered.

The true prevalence data for all fractured elements by cemetery and male and female groups are compiled in Appendix A.

4.2.3 Archival evidence of fracture

Table 4.7 displays the proportion of individuals entering the hospital due to fracture subdivided by sex. It was possible to assign sex to the majority of individuals in the hospital admissions dataset. More males than females were admitted to hospital; however, the proportion of males admitted to hospital for fractures was significantly higher than females ($\chi^2 = 8.222$, df = 1, $p < 0.05$). This result suggests that males were possibly engaging in occupations or behaviours that put them at increased risk of fracture or were more likely to seek hospital treatment for their fractures (see sections 6.2, 6.3.3, 6.3.4, and 6.4).

There is an increase in fracture-related admissions to the Middlesex Hospital between 1770-1779 and 1780-1789 in both the male and female groups. The Royal London hospital, by comparison, has lower overall proportions of individuals entering hospital due to fracture and by 1800-1809 only 1.5% of females admitted to the hospital were present due to fractures.

Table 4.7 Proportion of fractures compared with other reasons for admission to the Middlesex and Royal London hospitals

		Male Reasons for Admission			**Female Reasons for Admission**		
Decade	**Hospital**	**Fractures n (%)***	**Other**	**Total Admitted**	**Fractures n (%)**	**Other**	**Total Admitted**
1760-1769	Middlesex	216 (20.7)	826	1042	96 (23.3)	316	412
	Royal London	77 (10.8)	634	711	34 (5.7)	566	600
1770-1779	Middlesex	349 (18.4)	1550	1899	133 (17.5)	626	759
1780-1789	Middlesex	357 (25.1)	1064	1421	189 (27.7)	494	683
1790-1799	Royal London	159 (12.9)	1073	1232	52 (7.8)	612	664
1800-1809	Royal London	40 (11.7)	302	342	10 (1.5)	144	154
Total		**1198**	**5449**	**6647**	**514**	**2758**	**3272**

* - n represents the number of fractures, the percentage is the number of fractures divided by the total number of admissions per sex per decade.

As stated in Chapter 3, individuals may become lost to observation (Appendix C – Tables C.2 & C.3). In this investigation individuals lost to observation are defined as those individuals who were listed in the admission records as entering the hospital due to fracture, but for whom a discharge date or fate could not be ascertained. Some individuals are noted as having chosen to leave hospital, such as John Fisher, who was admitted to the Middlesex on 24 July 1786, but "left the House by his own desire [sic]" on 1 August 1786 (UCL, Middlesex Apothecary Reports, 1782-1788). It is possible that other individuals left without official leave and their actions were not recorded in the discharge records. Other individuals may have died in hospital; if so, their names would not have been recorded in the discharge records. Comprehensive death records are not available for all the general hospitals and some do not record the names of the dead, just an overall tally of weekly deaths and burials. Certain individuals may be lost to observation due to the incomplete available records. The records for St. Thomas' have several gaps and it is likely many of the 408 individuals lost to observation for St. Thomas' (Appendix C – Table C.2) were discharged in lost documents. It is also possible that individuals are lost to observation because I did not successfully identify them in the discharge records. The most common injury for both male and female individuals (Appendix C – Table C.3) lost to observation was a fractured leg (a category which included fractured femora, fibulae, and tibiae), followed by a fractured arm. There were substantially more male individuals lost to observation, but overall more male individuals were admitted to hospital than females (Table 4.7).

4.2.4 Differences in fracture frequency between the skeletal and archival datasets

Drawing upon the individuals with fractures in the skeletal sample and those individuals who were admitted to the Middlesex or Royal London hospitals due to fracture, the frequency of each fractured element was compared between the two datasets divided by sex. These data are tabulated in Table 4.8 and displayed graphically in Figures 4.5 and 4.6. The proportion of torso, hand, and foot fractures in both the male and female samples is significantly higher in the skeletal dataset. The proportion of leg fractures is significantly higher in both the male and female samples in the archival dataset. In addition, the proportion of male arm fractures is significantly higher in the archival dataset.

Table 4.8 – Distribution of fractured elements in skeletal and admission datasets displayed by sex

	Male Fractured Elements		**Female Fractured Elements**	
Category	**Skeletons**	**Admission Records**	**Skeletons**	**Admission Records**
Cranial	38 (10.5%)	98 (8.1%)	2 (1.8%)	26 (5.0%)
Torso	125 (34.5%)	113 (9.3%)	49 (43.8%)	32 (6.2%)
Arm	31 (8.6%)	223 (18.4%)	28 (25.0%)	113 (21.8%)
Hand	71 (19.6%)	14 (1.2%)	16 (14.3%)	1 (0.2%)
Leg	49 (13.5%)	748 (61.9%)	11 (9.8%)	341 (65.8%)
Foot	48 (13.3%)	13 (1.1%)	6 (5.4%)	5 (1.0%)
Total Fractured Elements	**362**	**1209**	**112**	**518**

Each cell displays the number of fractured elements observed in each anatomical category. The number of fractured elements in each anatomical category divided by total number of fractured elements in the dataset equals the percentage values. Statistically significant values are shaded.

Figure 4.5 Comparison of male fracture frequencies between skeletal and archival datasets

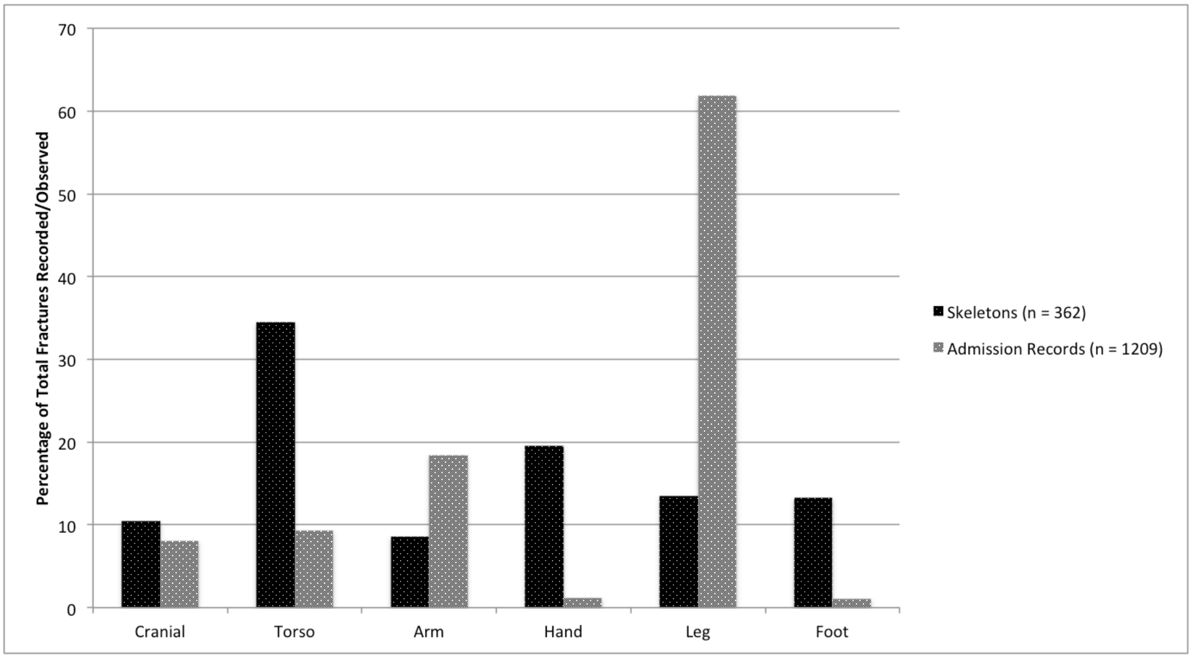
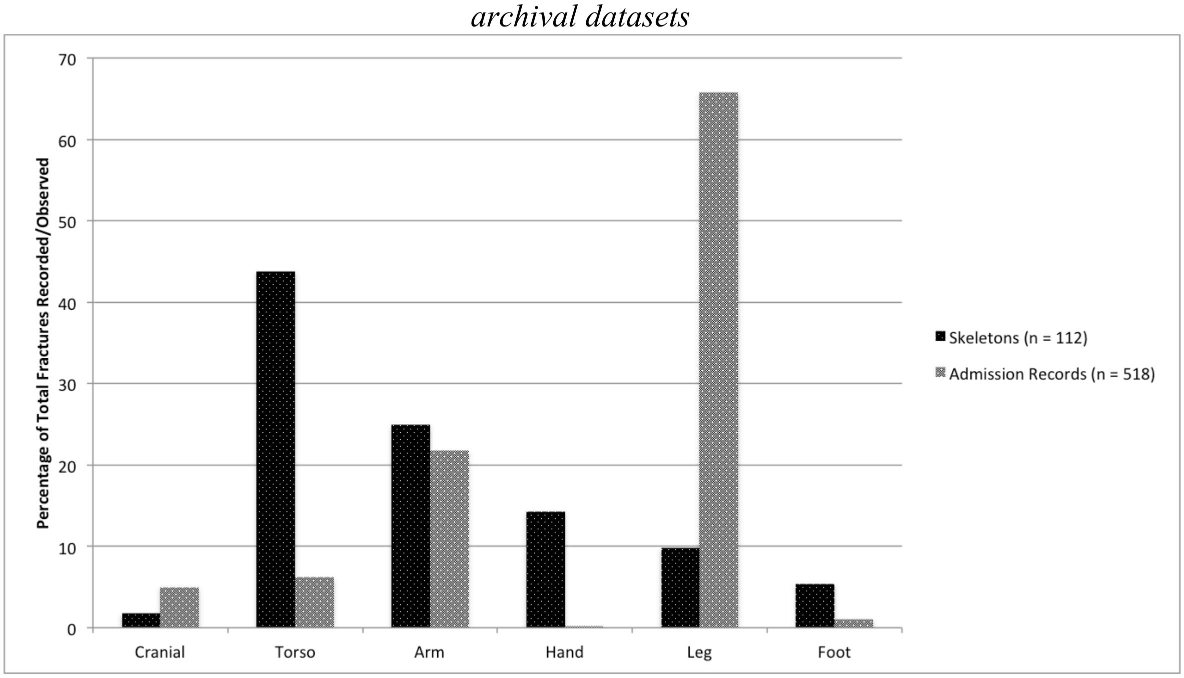


Figure 4.6 Comparison of female fracture frequencies between skeletal and archival datasets



Leg fractures have the greatest frequency in both males and females in the admission records for the Middlesex and Royal London hospitals. These fractures are described in detail in the surgeons' notebooks available for study. It appears that both male and female individuals were most likely to seek admission to a hospital for fractures that would affect their ability to walk, and therefore, in most cases, work. In contrast, fractures to the hands and feet are significantly more common in the skeletal dataset. The relatively low number of hospital admissions due to hand and finger fractures suggests that small fractures to the extremities were likely treated at home or with the aid of alternative practitioners. The process of gaining admission to a hospital was complicated, thus it follows that a fracture to the extremities, particularly if it was not a compound injury, would not warrant a hospital visit.

Where then, are the leg fractures in the archaeological record? There are a variety of possibilities. First, simple sampling bias may be the culprit; the individuals who were excavated and made available for study may not be representative of the larger population of London. Second, it is also possible that an individual suffered a leg fracture, was recorded in the hospital records, convalesced, left hospital, and, at some point between the injury and their death, left London and was buried elsewhere. Third, individuals who died in hospital during the "long" eighteenth century may have been subjected to autopsy and anatomization (Chamberlain, 2012; Chaplin, 2012; Mitchell et al., 2011). Mitchell and Chauhan (2012) posit that conditions such as severe fractures would have been relatively simple to identify in living patients; museum curators, therefore may have known in advance of an individual's death that they wanted to include a particular anatomical specimen in the collection. Femoral fracture specimens were numerous in the St. Bartholomew's Anatomical Museum (1846); of the 239 bony specimens representing fractures and dislocations 70 (29.3%) were human femora. There is ample evidence for anatomization at the Royal London Hospital (Fowler & Powers, 2012, p. 90) such as "non-survivable interventions," including craniotomies. Some skeletal elements had been dyed or were found with wires, screws, or pins in place, indicating the elements had been articulated and possibly used for teaching.

The common nature of rib fractures is clear from both the skeletal and archival data. The skeletal data provides more detail on the location and side of the fracture, which may be clues as to the etiology of the injury. The archival data provides a tighter age estimate for individuals suffering a rib fracture and the length of stay in hospital may be an indication of injury severity. Roberts and Cox (2003) compiled data on 32,865 individuals from 201 different archaeological sites covering the Roman to the post-medieval period. In each time period (Roman, early medieval, late medieval, post-medieval), rib fractures were the most frequently fractured element. Ribs are the most frequently fractured element for both males and females in the skeletal sample; in the admissions sample ribs are the fourth most frequently fractured element for males and the fifth for the female sample. The under-reporting of rib fractures is an issue in modern epidemiological studies (Brickley, 2006; Jurmain, 1999; Warden, Gutschlag, Wajswelner, & Crossley, 2002), though rib fractures are the most common clinically reported injury to the thorax (Kramaker & Anthony, 2003; Tekinbas et al., 2003).

The significantly higher proportion of hand and foot fractures in the skeletal dataset is supported by modern clinical evidence. As discussed above, fractures of the manual phalanges and metacarpals are among the most common clinically, accounting for 10% of all fractures (Bernstein & Chung, 2006). When combined with carpal fractures, these hand fractures account for 55% of fractures of the upper limb (Chung & Spilson, 2001). Fractures to the toes are also common; two studies of orthopedic cases dealt with by family physicians found that fractured toes comprised about 9% of all fractures treated (Eiff & Saultz, 1993; Hatch & Rosenbaum, 1994). Van Vliet-Koppert et al. (2011), in a functional outcome survey, discovered that 75.6% of toe fractures were caused by stubbing or crushing injuries; 38.1% of the fractures were to the first toe and 30.5% to the fifth toe. Unless injuries to the fingers and toes were compound or otherwise complex, it was unlikely that an individual would go through the arduous process of seeking hospital treatment for an injury that could be treated at home by splinting or bandaging. David Murphy sought hospital treatment at St. Bartholomew's for a compound luxation of the thumb, which resulted in a 39-day hospital stay while the symptoms of mortification were treated (St. B, MR 8, n.p.). The only other reference to an extremity fracture found in the consulted surgeons' casebooks was George Rogers, a 13-year-old boy who had suffered a crushed wrist; the distal radius, carpals, all five metacarpals, and several fingers were affected. He underwent an amputation one third of the way up his forearm, which healed and he left hospital after a stay of about four months (St. B, MR 16/1, p. 48). Dramatic hand and finger injuries such as these were evidently deemed worth the admission process.

Ultimately, the fractured elements most frequently appearing in the skeletal sample, such as the metacarpals, nasals, and proximal phalanges are relatively minor injuries that would not totally impede an individual's ability to move and work. Surgeons referred to fractured fingers as trivial cases (Bristowe & Holmes, 1864). Lay first-aid was often adequate; Roy Porter asserts that "experienced and careful lay people could handle most accidents, even serious-sounding conditions such as fractures" (1997, p. 96). William Buchan, in his landmark publication *Domestic Medicine,* in reference to fractures, notes that

> there is in most country villages some person who pretends to the art of reducing fractures. Though in general such persons are very ignorant, yet some of them are very successful; which evidently proves, that a small degree of learning, with a sufficient share of common sense and a mechanical head, will enable a man to be useful in this way
>
> (1769, p. 722).

Buchan does, however, caution that "we would however advise people never to trust such operators, when an expert and skillful surgeon can be had; but when that is impracticable, they must be employed" (1769, p. 722). In cases where a fracture was deemed minor, or the hospital admissions procedure was too laborious, or a governor's recommendation was unprocurable, "every man is in some measure a surgeon whether he will or not" (Buchan, 1769, p. 695).

The limitations of the archival hospital admissions data are the same as those outlined by Court-Brown and Caesar (2006), namely: inexperienced doctors may over-diagnose particular fractures, not all fractures are referred to orthopedic fracture clinics, and orthopedic trauma may be managed at many hospitals in a large city and a single hospital's epidemiological patterns may not be reflective of the entire city. Further, the historical hospital admissions do not detail the location of the fracture. Court-Brown and Caesar's retrospective study of the Royal Infirmary of Edinburgh (2006) shows that femoral fractures are the second most common fracture (male and female data pooled), though the location of the fracture (i.e., proximal/distal etc.) makes a difference in the ranking. Fractures to the proximal femur (n = 697) were far more common than fractures to the femoral diaphysis (n = 55) or distal femur (n = 24) (following Court-Brown & Caesar, 2006, p. 692).

Court-Brown and Caesar's (2006) work showed that 60% of the fractures attended to by modern orthopedic surgeons were of the distal radius, metacarpals, manual phalanges, ankle, and proximal femur. These results, particularly the inclusion of the metacarpals, manual phalanges, and ankle, relate to the skeletal fracture results. These fractures appear commonly in the skeletal results, but are not reflected in the historical hospital admission records. It is possible that modern individuals are more likely to seek medical care for these types of injuries than the working poor of "long" eighteenth century London.

4.3 SUMMARY

This chapter outlines the broad patterns of fracture frequency found in the skeletal and hospital admission datasets. In the skeletal samples males had a greater frequency of antemortem and perimortem fractures than females overall. The body area with the highest frequency of fractures in the skeletal dataset was the torso for both the male and female skeletal samples. When the two lines of evidence are compared it is clear that long bone fractures, particularly to the lower limbs, appear in the hospital admission records most frequently and comparatively minor injuries, such as facial and hand fractures, appear more frequently in the skeletal dataset. This suggests that individuals were seeking hospital admission for comparatively major injuries, while either treating minor injuries to the extremities themselves or seeking the services of alternative practitioners.

Chapter 5.0 – RESULTS and DISCUSSION: Sex- and Age-Based Patterns in Fracture Prevalence

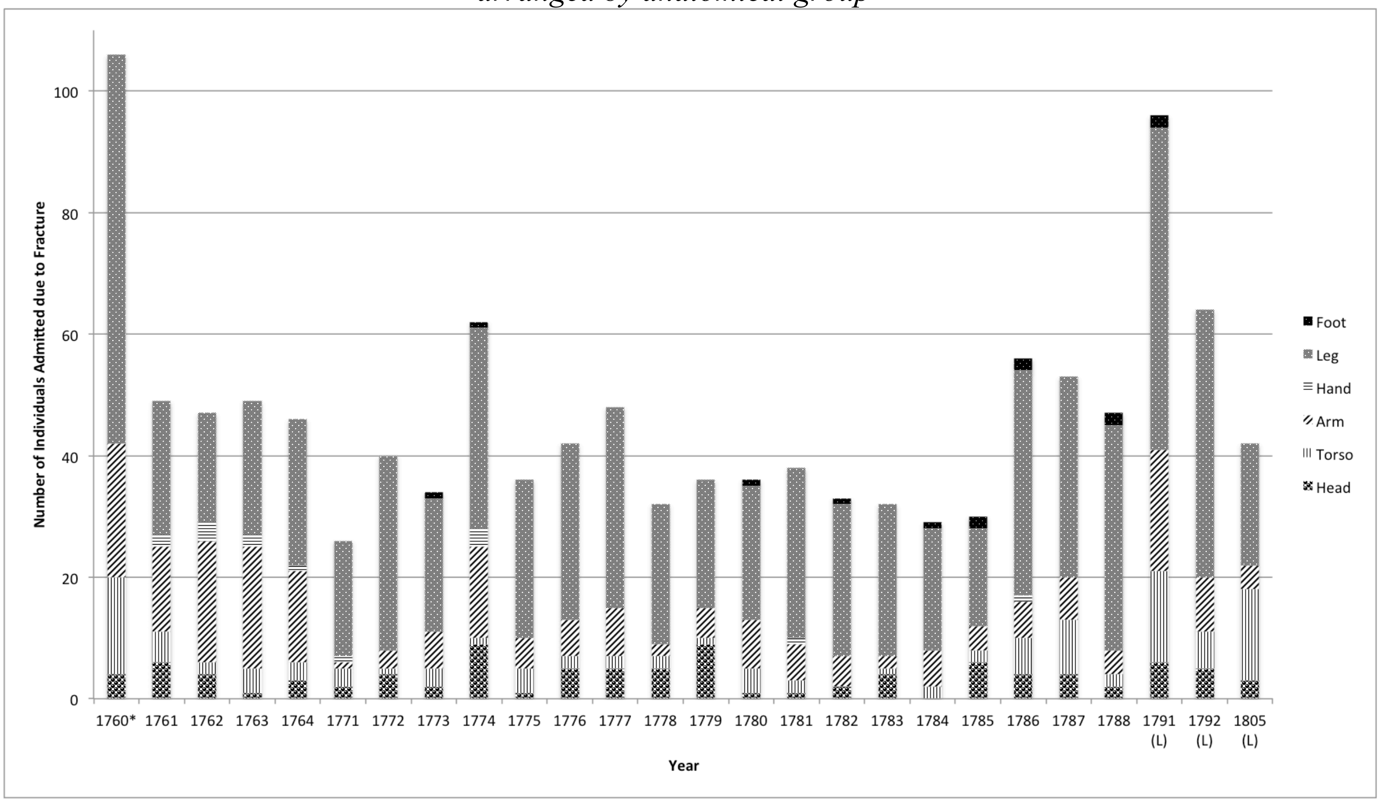
5.1 INTRODUCTION

In this chapter I investigate the sex-based differences in fracture prevalence and distribution found in the skeletal and admission record datasets. I begin by comparing the crude prevalence of fractures in the six anatomical categories employed in Chapter 4. I then outline the five most common fractured elements observed in the skeletal dataset and recorded as reasons for admission. I compare these rankings and place the highest ranked fractures into their clinical and historical context, drawing upon contemporary biomedical literature and the notebooks of physicians and surgeons operating during the "long" eighteenth century in London.

5.2 SEX-BASED DIFFERENCES IN FRACTURE PREVALENCE

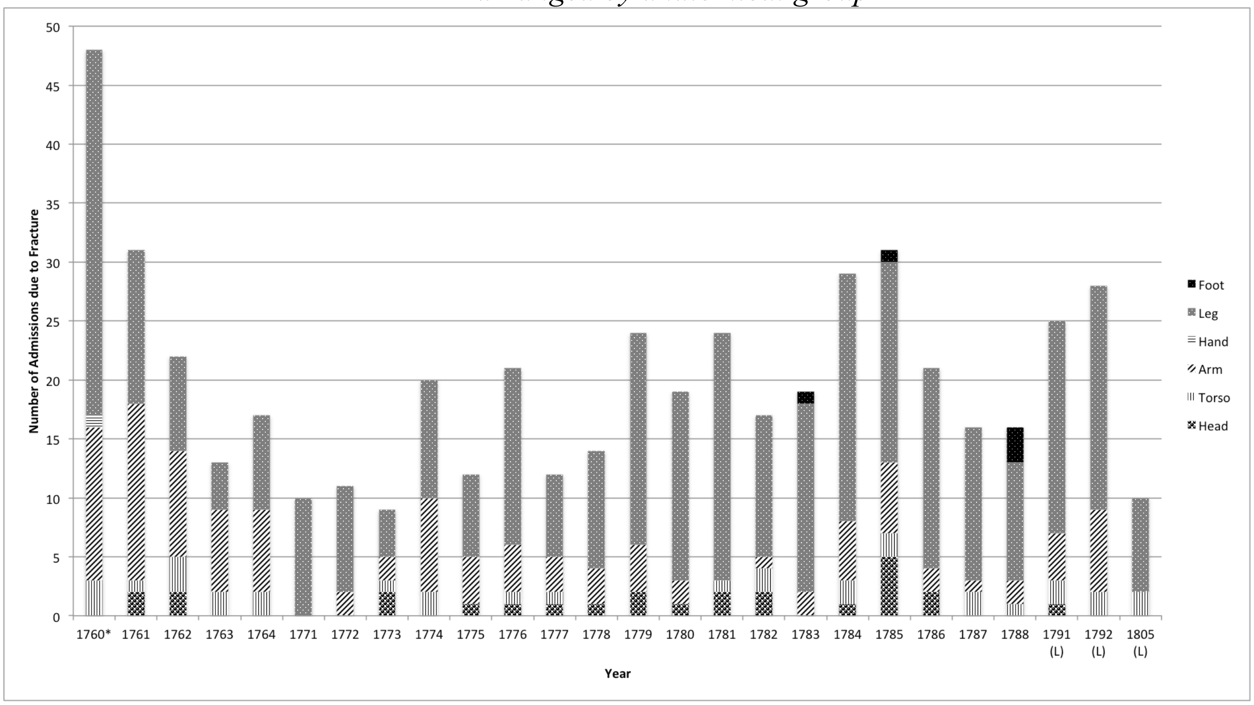
In order to explore general patterns in the skeletal data between males and females, the skeletal elements were grouped in anatomical categories (outlined in Sections 3.2.5.5 and 3.3.3.4) and the crude prevalence of individuals affected by fractures by element were compared using Chi square tests (Appendix A, Tables A.10-A.15). When these categories were compared between the male and female groups the cranial, torso, leg, hand, and foot categories had a statistically significant higher prevalence of fractures in the male group than the female group. The hospital admissions results were compared between male and female groups using Chi-square tests (Appendix C, Tables C.7-C.12). There was a statistically significant higher proportion of cranial, torso, and hand fractures found in the male group compared to the female group. These data are displayed visually in Figures 5.1 (males) and 5.2 (females). There were data available for both the Royal London and Middlesex hospitals in 1760; these data were pooled.

Figure 5.1 – Male admissions data for the Royal London and Middlesex hospitals arranged by anatomical group



* (L) = data only available from the Royal London Hospital. Data were only available for the latter half of 1805.

Figure 5.2 – Female admissions data for the Royal London and Middlesex hospitals arranged by anatomical group



* (L) = data only available from the Royal London Hospital. Data were only available for the latter half of 1805.

The majority of the available fracture data come from the Middlesex (1760-1764, 1771-1788). The number of annual male admissions due to fracture ranged between 26 and 62. There was a spike in male fracture admissions in 1774, 1786, and 1787. For the three full years for which data are available, the Royal London had more male admissions than the Middlesex, ranging between 77 and 96. The average annual number of male fracture admissions at the Middlesex was 66.7, while for the Royal London (excluding the incomplete dataset for 1805) the average was 79. The number of annual female admissions due to fracture ranged between 9 and 31 individuals at the Middlesex. The Royal London had a range of annual female admissions from 25 to 34 individuals. Female admission at the Middlesex appears to spike in 1761, 1784, and 1785. The average annual number of female fracture admissions at the Middlesex was 18.3, and 29 at the Royal London.

Males in both datasets were more likely to have cranial, torso, and hand fractures. To explore the significance of these results I ranked the most commonly fractured elements in each dataset for males and females.

The skeletal and admission records datasets provide variable levels of detail concerning fracture locations. Table 5.1 displays the top five most frequent fractures found in the skeletal dataset, displayed by sex, element, and individual. The most frequently fractured elements by individual admission, derived from the Middlesex and Royal London admission registers are displayed in Table 5.2. Appendix D displays the total number of observable skeletal elements.

Table 5.1 Most frequently fractured elements by number of elements and individuals in skeletal dataset

Males				**Females**			
Element	No. elements	Rank	No. individuals	Element	No. elements	Rank	No. individuals
Ribs	339	1	100	Ribs	127	1	41
Nasal	53	2	34	Radius	18	2	18
MC1*	26	3	25	Thoracic vertebra	7	3	5
Fibula	26	3	21	Ulna	6	4	6
Thoracic vertebra	24	4	13	Navicular	5	5	4
Proximal manual phalanx	15	5	15	Proximal manual phalanx	5	5	3

* MC1 = metacarpal 1

The top ranked element for both males and females were the ribs, both by number of individuals and elements affected. There were 41 female individuals with a total of 127 fractured ribs and 100 males with 339 fractured ribs. In the skeletal sample the ratio of males with rib fractures to the total number of males is approximately 1:4. The ratio of female individuals with rib fractures to the total number of females in the skeletal sample is approximately 1:7.5.

Table 5.2 Most frequently fractured elements by individual in the Middlesex and Royal London datasets

Males			**Females**		
Element	No. Individuals Admitted for Fracture	Rank	Element	No. Individuals Admitted for Fracture	Rank
Leg/Thigh/Femur	689	1	Leg/Thigh/Femur	289	1
Arm	144	2	Arm	81	2
Rib/Ribs	105	3	Knee/Patella	43	3
Skull/Head	70	4	Rib/Ribs	32	4
Clavicle	53	5	Skull/Head	23	5

The leg/thigh/femur, arm, and rib fracture groups make up the top three most frequently fractured elements in the male admission records. The fractures in Table 5.2 are organized by individual since it was not possible to access an element count in the archival results. In females the top three fracture groups are leg/thigh/femur, arm, and knee/patella. Spearman's rho was calculated using data from Tables 5.2 and C.6 for the six anatomical categories found in Table 5.2. The r_s was 0.6571, indicating a strong positive correlation between the two datasets, meaning that males and females were seeking hospital care for similar types of fractures; most commonly fractures to the leg/thigh/femur and the arms. Despite most commonly seeking admission to hospital for certain fractures, the rank distribution of the most common fractures differs between the males and females in the admission records. These results suggest that males and females encountered different fracture risks.

5.3 CLINICAL AND HISTORICAL DESCRIPTIONS OF THE MOST FREQUENTLY OBSERVED SKELETAL FRACTURES

Table 5.3 displays the age distribution of individuals who were observed to have the top five fractured elements for both males and females in the skeletal sample. The longer an individual lives, the greater their chance to accumulate fractures. Individuals in the Older Adult category had the highest proportion of most of the more frequently fractured skeletal elements. Two interesting exceptions are the male nasal and female navicular results, both of which have higher proportions of individuals with these fractures in the Middle Adult 2 category. The sample size of female navicular fractures is small (n = 4), thus any conclusions are drawn with extreme caution, but the potential of hormonal fluctuations, amennorhea, and stress are discussed in section 5.3.8 in relation to navicular fractures. The higher frequency of nasal fractures among males in the Middle Adult 2 category potentially suggests that individuals who suffered nasal fractures were less likely to live to older ages, though the small sample sizes necessarily make this an equivocal conclusion. The connection of nasal fractures to social stresses and violent male behaviour is discussed in sections 6.3.3 and 6.3.4.

Table 5.3 Age distribution of individuals with the most frequently fractured skeletal elements

Element	**Males**					
	YA* n (%)	MA1 n (%)	MA2 n (%)	OA n (%)	AM n (%)	Total
Ribs	1 (1.0)	9 (9.0)	34 (34.0)	47 (47.0)	9 (9.0)	100
Nasal	1 (2.9)	3 (8.8)	14 (41.2)	12 (35.3)	4 (11.8)	34
Metacarpal 1	0	3 (12.0)	9 (36.0)	13 (52.0)	0	25
Fibula	0	5 (23.8)	7 (33.3)	7 (33.3)	2 (9.5)	21
Thoracic vertebra	1 (7.7)	3 (23.1)	4 (30.8)	5 (38.5)	0	13
Proximal manual phalanx	1 (6.7)	1 (6.7)	6 (40.0)	6 (40.0)	1 (6.7)	15
Element	**Females**					
	YA n (%)	MA1 n (%)	MA2 n (%)	OA n (%)	AF n (%)	Total
Ribs	0	6 (14.6)	15 (36.6)	20 (48.8)	0	41
Radius	0	1 (5.6)	4 (22.2)	12 (66.7)	1 (5.6)	18
Thoracic vertebra	0	0	0	2 (40.0)	3 (60.0)	5
Ulna	0	1 (16.7)	2 (33.3)	3 (50.0)	0	6
Navicular	0	1 (25.0)	2 (50.0)	1 (25.0)	0	4
Proximal manual phalanx	0	1 (33.3)	1 (33.3)	1 (33.3)	0	3

* YA = young adult (18-25); MA1 = middle adult 1 (26-35); MA2 = middle adult 2 (36-45); OA = older adult (46+); AM = adult male; AF = adult female. Values in parentheses are percentages: number of fractured individuals in age category / total number of individuals with fractured element.

The ages of individuals admitted to the Royal London Hospital during the years 1760, 1791, and 1792 are recorded in the admission books (total number admitted = 3703); therefore, it is possible to construct an age distribution for these years (Table 5.4). The age categories are the same as those used in Table 5.3, based upon the guide by Connell and Rauxloh (2003). The admission record age data are displayed graphically in Figures 5.3 and 5.4 organized by decade. These data display the age at which a fracture occurred and an individual sought hospital care; the skeletal age estimations reflect an individual's age at death. Despite these differences, the age distribution data may be used to supplement the investigation of individuals' fracture risk throughout the life course.

The different ages at which males and females were recorded as seeking hospital admission for the same category of fractures (e.g., leg/thigh/femur) suggests that there may have been both sex- and age-based factors in risk.

Table 5.4 Age distribution of individuals with the most frequently fractured skeletal elements from the Royal London Hospital (1760, 1791, 1792)

Element	**Males**					
	YA* n (%)	MA1 n (%)	MA2 n (%)	OA n (%)	AM n (%)	Total
Leg/Thigh/Femur	20 (15.7)	40 (31.5)	26 (20.5)	39 (30.7)	2 (1.6)	127
Arm	4 (14.8)	5 (18.5)	7 (25.9)	10 (37.0)	1 (3.7)	27
Rib/Ribs	2 (6.1)	4 (12.1)	13 (39.4)	14 (42.4)	0	33
Skull/Head	2 (33.3)	0	2 (33.3)	2 (33.3)	0	6
Clavicle	4 (44.4)	2 (22.2)	2 (22.2)	1 (11.1)	0	9
Element	**Females**					
	YA n (%)	MA1 n (%)	MA2 n (%)	OA n (%)	AF n (%)	Total
Leg/Thigh/Femur	5 (9.3)	3 (5.6)	18 (33.3)	28 (51.9)	0	54
Arm	2 (14.3)	2 (14.3)	2 (14.3)	8 (57.1)	0	14
Knee/Patella	1 (16.7)	0	2 (33.3)	3 (50.0)	0	6
Rib/Ribs	0	2 (40.0)	2 (40.0)	1 (20.0)	0	5
Skull/Head	0	0	0	1 (100.0)	0	1

* YA = young adult (18-25); MA1 = middle adult 1 (26-35); MA2 = middle adult 2 (36-45); OA = older adult (46+); AM = adult male; AF = adult female. Values in parentheses are percentages: number of fractured individuals in age category / total number of individuals with fractured element.

Figure 5.3 Age distribution of Royal London Hospital males with top ranked fractures

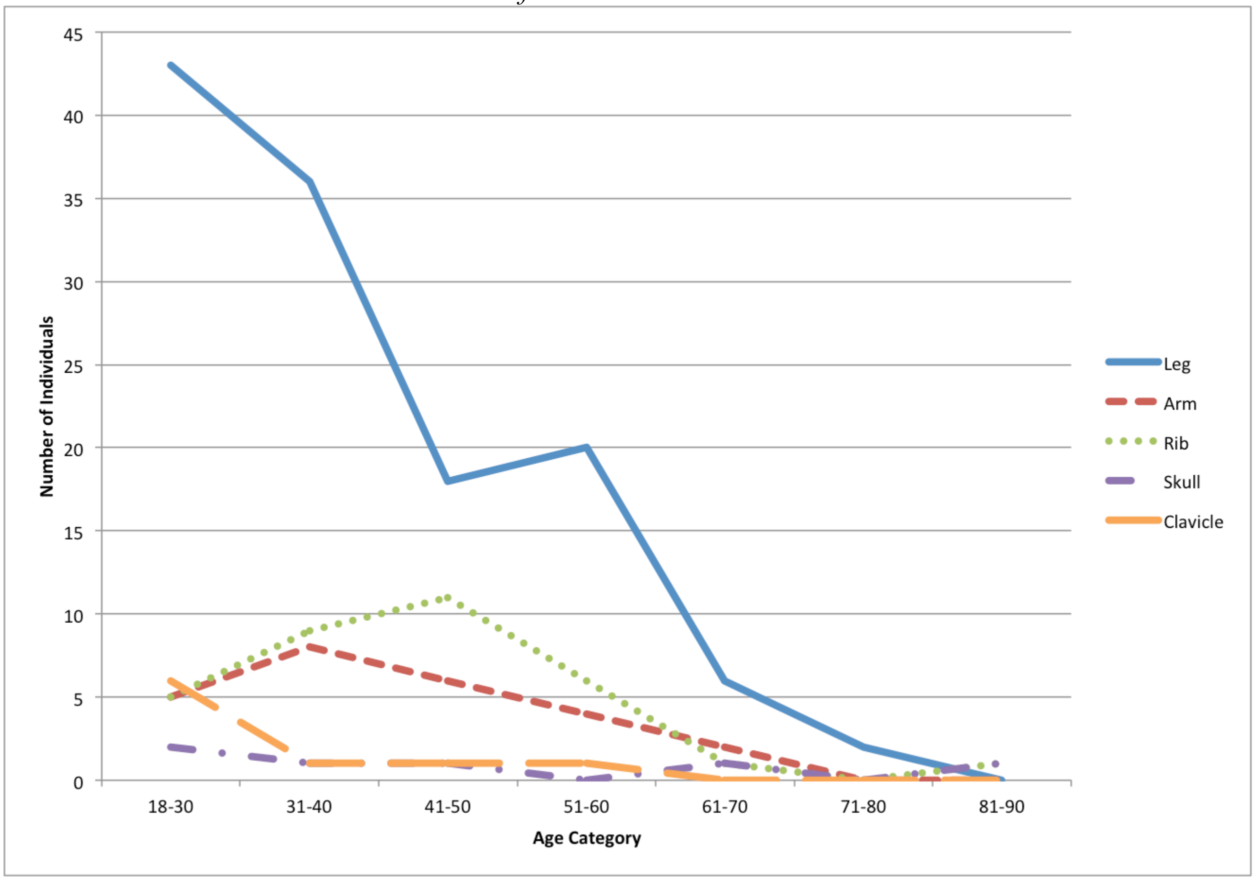
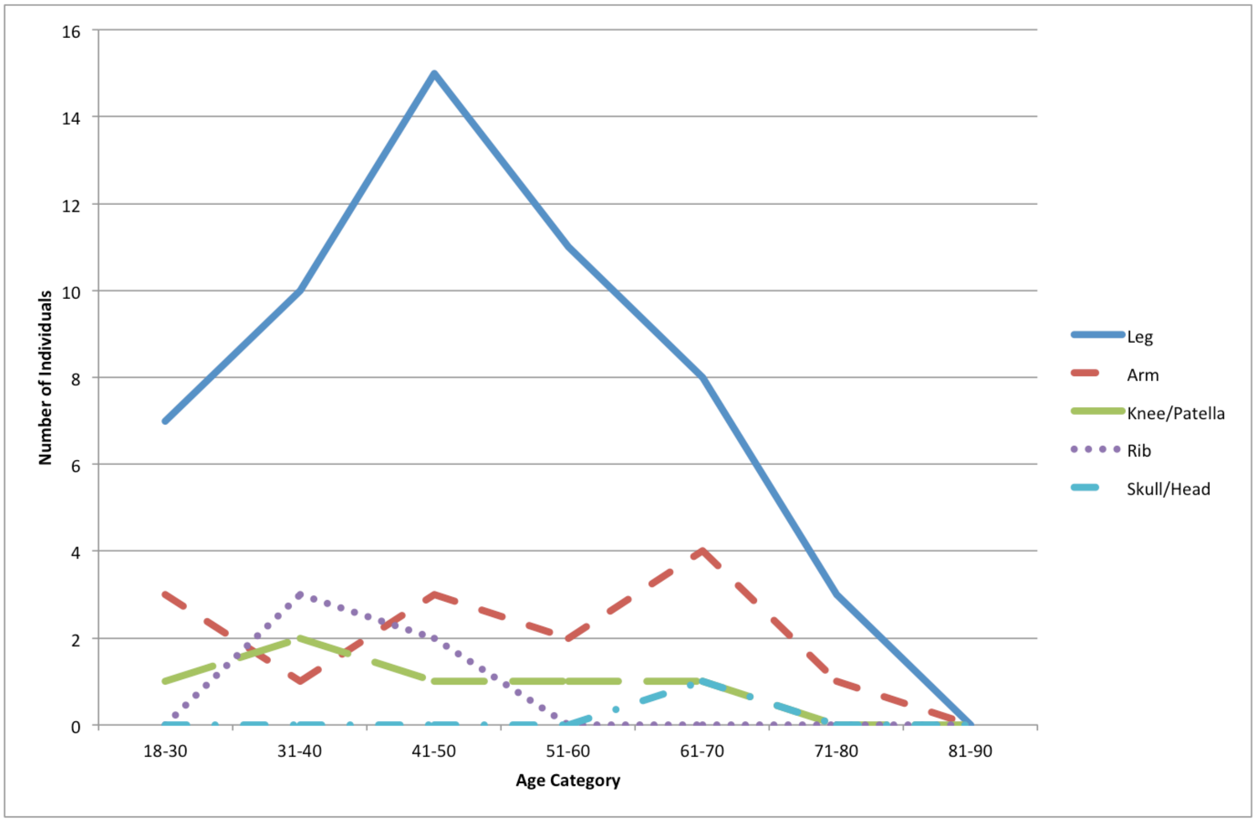


Figure 5.4 Age distribution of Royal London Hospital females with top ranked fractures



***5.3.1 Ribs** – Males (Skeletal Rank 1, Admissions Rank 3), Females (Skeletal Rank 1, Admissions Rank 4)*

Fractures to the ribs were the most numerous category of fracture in both the male and female skeletal samples. There were 339 fractured ribs in various stages of healing in 100 male individuals and 127 fractured ribs in 41 females. The number of individuals in the skeletal dataset with fractured ribs increased throughout the age categories with 47.0% (47/100) of male individuals with rib fractures falling in the OA category, comparable to 48.9% (20/41) of female individuals. Ribs were the third most common (n = 105) area of fracture in the male admissions sample and the fourth most common (n =

32) in the female sample (Table 5.2). The age of individuals entering the Royal London Hospital for rib fractures reveals that males in the MA2 (n = 13) and OA (n = 14) categories were the most numerous (Table 5.4).

Table 5.5 displays the regions and sides of the fractured ribs that could be assigned to a side.

Table 5.5 Rib cage regions of sided skeletal rib fractures

	Males		**Females**	
Rib Cage Region	Left n (%)	Right n (%)	Left n (%)	Right n (%)
Upper (1-3)	5 (2.0)	4 (1.6)	3 (3.3)	0
Mid (4-9)	70 (28.5)	86 (35.0)	38 (42.2)	31 (34.4)
Lower (10-12)	25 (10.2)	30 (12.2)	3 (3.3)	9 (10.0)
Unknown*	9 (3.7)	17 (6.9)	3 (3.3)	3 (3.3)

* Unknown ribs were shaft fragments missing a rib head that could not be definitely assigned into a region. Values in parentheses are percentages: number of ribs in category / total number of sided ribs in male or female skeletal sample.

The majority of rib fractures occurred in the midcage ribs in both the male and female skeletal samples. This is similar to clinical reports that, while inconsistent in their definition of what constitutes the midcage, report this as the area most prone to rib fractures (e.g., Kara, Dikmen, Erdal, Simsir, & Kara, 2003 (fourth to tenth ribs); Nadalo & Jones, 2013 (fifth to ninth ribs); Sirmali et al., 2003 (fourth to ninth ribs)).

Rib fractures may occur due to a variety of factors, including blows to the chest, falls (DiMaio & DiMaio, 2001; Kerr-Valentic, Arthur, Mullins, Pearson, & Mayberry, 2003; Marmor, 1969; Stawicki, Grossman, Hoey, Miller, & Reed, 2004), assaults (Sirmali et al., 2003) and accidents; the sixth, seventh, and eighth ribs are the most commonly fractured, more often on the left side (Wedel & Galloway, 2014). Coughing has also been known to produce rib fractures, particularly in the midcage ribs (ribs 4-9) of the elderly (Begley, Wilson, & Shaw, 1995; de Maeseneer, de Mey, Debaere, Meysman, & Osteaux, 2000; Hillenbrand, Henne-Bruns, & Wurl, 2006; Nadalo & Jones, 2013). Fractures to the upper ribs (ribs 1-3), which are protected from force by the pectoral girdle, tend to be associated with major trauma such as motor vehicle accidents and are usually associated with significant chest injuries (e.g., Bassett, Gibson, & Wilson, 1968; Poole & Myers, 1981; Richardson, McElvein, & Trinkle, 1975) or muscular pulls (Matsumoto et al., 2003; Waxman & Geshelin, 1947). Blunt force trauma to the chest that produces rib fractures is linked to relatively high mortality in contemporary groups, ranging from 4-20% (e.g., Quaday, 1995; Ziegler & Agarwal, 1994) and increased age has been noted as a significant risk factor for mortality from rib fractures (Battle, Hutchings, & Evans, 2011). Clinically, rib fractures are classified as transverse and oblique. Transverse fractures occur more commonly and are linked to direct blows to the chest with a fast-acting force (Watson-Jones, 1941). Oblique fractures are usually found on the lateral curve of the ribs and are linked to falls from a height and the effects of motor vehicle accidents (Watson-Jones, 1941; Wedel & Galloway, 2014).

The majority of rib fractures observed were antemortem healed rib fractures. There were, however, 38 rib fractures (in 14 individuals) that were actively healing at the time of the individual’s death.

Table 5.6 Age categories of individuals with skeletal healing rib fractures

Age Category	**Male** n (%)	**Female** n (%)
YA (18-25)	0	0
MA1 (26-35)	1 (7.1)	0
MA2 (36-45)	6 (42.9)	0
OA (46+)	3 (21.4)	3 (21.4)
AD	1 (7.1)	0
Total	11	3

Values in parentheses are percentages. Number of individuals in category / total number of individuals with actively healing rib fractures.

The age categories of individuals with healing rib fractures are tabulated in Table 5.6. The largest group of individuals with healing rib fractures (6/14 = 42.9%) were males in the MA2 category. This result approximately corresponds with the age at which most males were entering the Royal London Hospital due to rib fractures (Figure 5.3), suggesting that the period between about age 35 and 45 may have been a period of higher risk for males to suffer rib fractures, though the small number of healing fractures prevents unequivocal conclusions from being drawn. The age at which individuals are seeking hospital admission for rib fractures in both the male and female samples increases from age 18 with a peak for males in the 41-50 group and for females in the 31-40 age group (Figures 5.3 and 5.4). Kanis et al. (2001) have suggested that rib fractures should be considered as part of a suite of age-related fractures, also including the femur, clavicle, scapula, and sternum. Clinically, older individuals are more prone to rib fractures than the young (van Hensbroek, Mulder, Luitse, van Ooijen, & Goslings, 2009) and they are at greater risk for pneumonia and death (Bergeron et al., 2003; Stawicki et al., 2004). In elderly patients, rib fractures are the most common injury in cases of blunt force trauma to the chest; with each additional rib fracture the chance of developing pneumonia increases by 27% and the risk of mortality increases by 19% (Bulger, Arneson, Mock, & Jurkovich, 2000; Shorr et al., 1989). The increased morbidity associated with age and rib fractures likely contributed to the rise in rib fracture admissions at the Royal London hospital with increasing age.

The length of stay in hospital for individuals with rib fractures (drawing upon data from the Royal London, Middlesex, St. Thomas', and Guy's hospitals) was an average of 30.0 days for males and 23.1 days for females (see Appendix C, Table C.13).

Kerr-Valentic et al. (2003), from their clinical study in Oregon, USA, estimated that an average of 70 days of work are lost for modern-day individuals suffering a rib fracture. Clinical studies have revealed that even a single rib fracture can cause enough pain to lower an individual's quality of life and affect their ability to work (Kara et al., 2003).

Rib fractures are described in surgeons' notebooks from the "long" eighteenth century as a common injury. Benjamin Brodie, surgeon at St. George's Hospital, noted that "the yielding motion of the ribs prevents their being fractured so often as they would else be, but from their being so much exposed to injury, the fracture is nevertheless very frequent" (1805-1807, n.p.). Patients admitted to hospital with rib fractures would be treated with "a bandage, passed several times round the thorax, so as to compress the ribs, and prevent their motion in respiration" (Brodie, 1805-1807, n.p.). Individuals who died in hospital were often autopsied; surgeons could then identify exactly which ribs were fractured.

Patients brought to hospital for rib fractures recounted many different types of accidents that led to their fractures. James Smith fell 24 feet from a platform to the ground onto his left side and was brought to St. George's Hospital insensible; he was treated and after a month in bed felt weak, but was able to walk around unassisted (Brodie, 1824-1827, p. 248). Another male died in hospital after being "squeezed between a wheel and a wall," an incident which, among other injuries, broke his second through fifth ribs on the right side (St. B, MR 16/1, p. 23). Two individuals were admitted to St. Bartholomew's Hospital with rib fractures due to accidental falls. Dennis McCarthy, 57 years old, was described as an "old asthmatic man" who "slipped in getting out of bed," (St. B, MR 16/1, p. 57). Margaret Welch, 48 years old, fractured "one or two" ribs on her right side after a fall (St. B, MR 16/1, p. 29). She was admitted to hospital and spent 11 days resting. Brodie notes that he could hear "the cuputation of the broken rib…as a loud dull creak in each inspiration" (St B., MR 16/1, p. 29). Industrial accidents, falls, and vehicular accidents appear to be common causes of rib fractures.

Rib fractures, despite their common nature, could prove dangerous. Brickley (2006) compiled a list of serious complications such as flail chest, hemothorax, and pneumothorax that may develop due to rib fractures. Indeed, pulmonary complications are a dangerous possible outcome of rib fractures (Bulger, Arneson, Mock, & Jurkovich 2000; Flagel et al., 2005; Holcomb, McMullin, Kozar, Lygas, & Moore, 2003; Sirmali et al., 2003; Ziegler & Agarwal, 1994), though Matos (2009) cautions that it may be difficult to connect rib fracture patterns with their etiology, even when cause of death information is available. William Jones, who was admitted to Westminster Hospital on

December 15, 1818 for fractured ribs, needed to be bled "20 oz the night of admission & 14 oz the next day" due to fragments of broken rib driving into the lung, causing a collapsed lung and collection of fluid (RCS, MS0162, n.p.). Two anonymous individuals, a male and female, were brought into St. Bartholomew's Hospital due to wagon-related rib injuries. A wagon had driven over the man's left shoulder and chest, snapping six of his ribs (second-seventh, left side); this injury would prove fatal due to a ruptured lung (St. B, MR 16/1, p. 19). The anonymous female died two days after her injury, having been knocked down by a cab onto her stomach, breaking four of her ribs (the seventh-tenth on the left side) and rupturing her spleen in the process (St. B, MR 16/1, p. 21).

5.3.2 Leg Fractures (Leg, Thigh/Femur, Fibula) *– Males (Skeletal Rank 3 (Fibula), Admissions Rank 1), Females (Skeletal Rank 6 (Fibula), Admissions Rank 1)*

Fractures to the leg were the most common fractured element for both males (n = 489) and females (n= 234) in the admission record dataset (Table 5.2). Thigh and femoral fractures were also common reasons for hospital admittance (males, n = 200; females, n = 55).

There was a positive linear correlation for the average number of both male and female individuals admitted to the Middlesex for leg fractures over time (Figure 5.5 and Figure 5.6). The years were divided into seasons: Fall (September, October, November), Winter (December, January, February), Spring (March, April, May), and Summer (June, July August). Admission for leg fractures varied annually, but when the overall average number of admissions was graphed using Excel, it revealed a positive linear correlation between increasing time and the number of leg fractures admitted to the Middlesex for both males and females. There was not a concurrent increase in the annual number of individuals admitted to either hospital, suggesting that either there was an increased number of leg fractures occurring or that individuals were increasingly likely to seek hospital care for their leg fractures.

Figure 5.5 Male admissions for leg fractures to the Middlesex Hospital

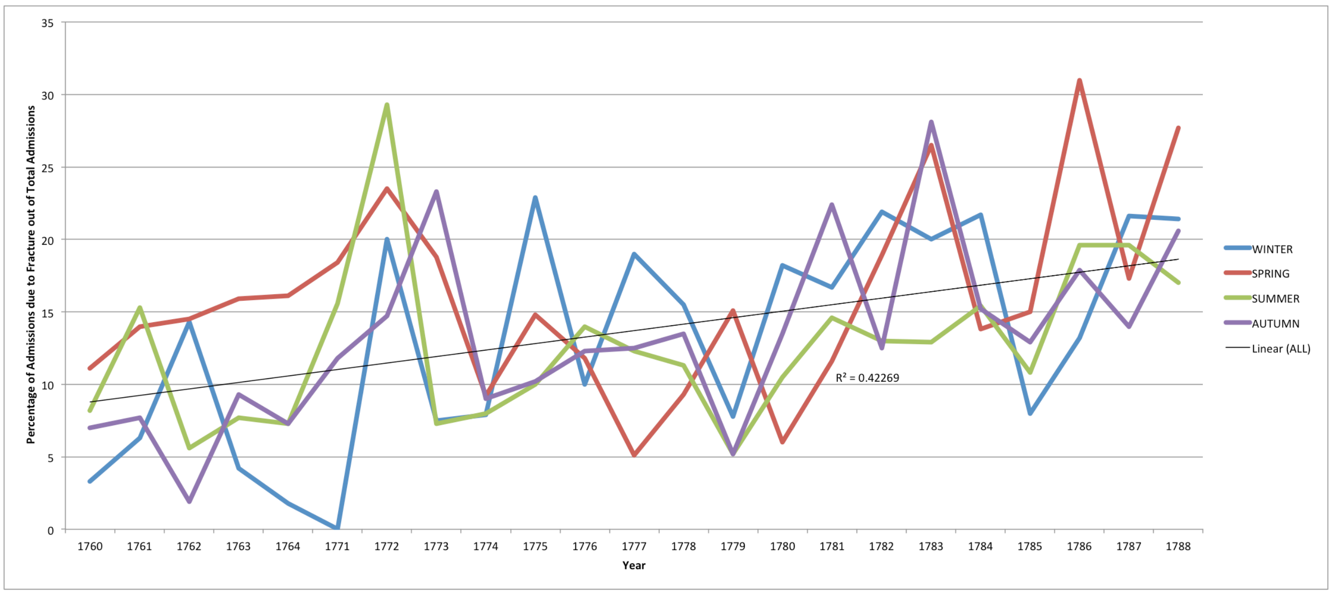
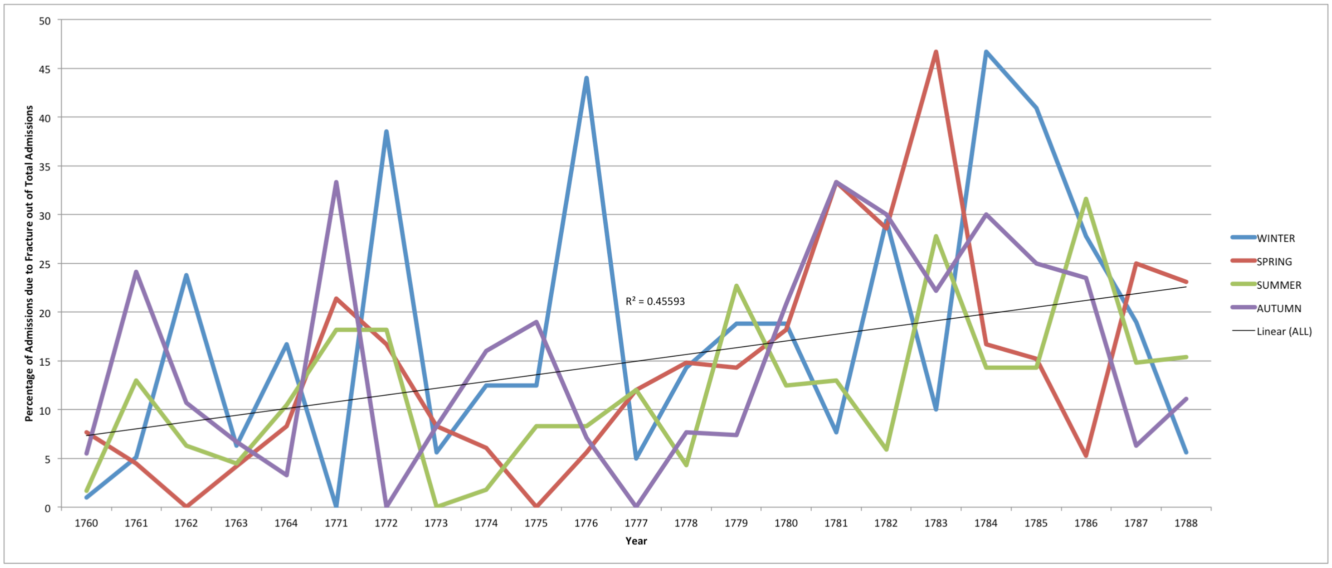


Figure 5.6 Female admissions for leg fractures to the Middlesex Hospital



The number of admissions due to fractures of the leg increases through time in the male and female groups. This is a less dramatic increase than found by Risse (1986) in the Royal Infirmary of Edinburgh, where the number of traumatic cases (a category including fractures, bruises, and wounds) increased sevenfold from the 1770s to the 1790s. Risse (1986) posits that this dramatic increase may have been associated with "new hazards of the early Industrial Revolution" (p. 158), but does not posit what these hazards may have been. Historians reflect upon the "volume of death and injury in factories, mines, building sites and shipyards" as an indication of the "astonishingly low status given to the issue of safety within society as a whole (Cooter & Luckin, 1997, p. 5) and the fact that "man-made industrial accidents…were increasingly seen as a part of the expected and 'normal' flow and structure of everyday social life" (Cooter & Luckin, 1997, p. 3). Accidents in general were common during the "long" eighteenth century; Roy Porter (1997) outlines "tragic falls, fires, drownings, firearms explosions, mishaps with tools and knives, potions and poisons" (p. 91), many of which could result in fractures or other trauma. Arthur Young (1771) described in detail the occupational risks to Sheffield knife grinders, whose grindstones sometimes broke apart resulting in the maiming or killing of the workmen. Traffic accidents were seemingly ubiquitous. Elizabeth Montagu – a preeminent society salon hostess dubbed 'Queen of the Bluestockings' by Samuel Johnson – wrote of road hazards: "I shall begin to think from my frequent overturns a bone-setter a necessary part of my equipage for country visiting" (Climenson, 1906, p. 33). It is likely that these hazards were also affecting individuals in London. It is also possible that the rise in admissions due to leg fractures is reflecting the increasingly common practice of taking urban accident victims to hospital. The Royal London hospital in particular was known for accident intake due to its location "in the centre of one of the densest and poorest districts, and in close proximity to the Docks" (Bristowe & Holmes, qtd. in Woodward, 1974, p. 130).

The age at which males and females are admitted to hospital differs (Figures 5.1 and 5.2). In the male sample, leg fractures are the most frequent in the 18-30 age category, the admissions drop from ages 31-50 and increase slightly in the 51-60 age group before dropping with increasing age. In contrast, the female leg fracture admissions steadily increase from age 18 to 50 before dropping off in frequency with increasing age. This pattern suggests that male and female risk factors for leg and thigh/femur fractures may be age-related. Age-related bone loss is a likely factor explaining the age-related patterning of female leg fractures. Clinical studies discuss the deleterious effects of old age on cortical thickness, trabecular connections, and cortex strength (e.g., Reeve &

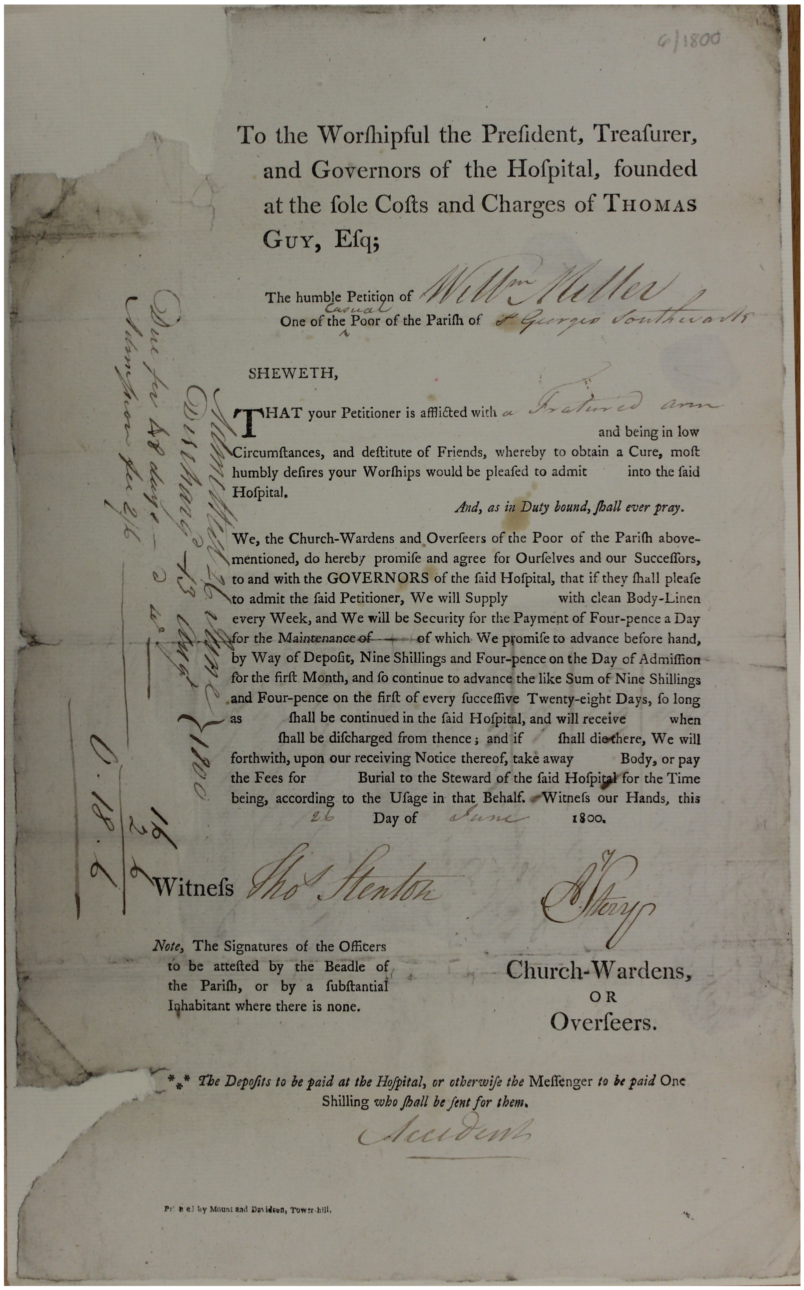
Loveridge, 2014; Yang et al., 2012), particularly in females (e.g., Carballido-Gamio et al., 2013; Johannesdottir et al., 2013; Poole et al., 2010). Male individuals admitted to hospital for a leg fracture spent an average of 66.9 days in care; similarly, female individuals with leg fractures spent an average of 68.2 days in hospital (Appendix C, Table C.13).

The lack of fracture location data limits the comparability of these data with epidemiological studies. Clinically, the relationship between increasing age and increasing incidence of hip fractures has been documented (Poole et al., 2010, using females aged 20-90 years) with females sustaining hip fractures at an average age of 77 and males at an average age of 72 (Baumgaertner & Higgins, 2002). Age-related bone loss and increased bone fragility due to an underlying condition such as osteoporosis may be a possible co-morbidity in the hospital admissions sample, but this supposition remains necessarily speculative. The small sample group of individuals in the older adult age groups may indicate that fewer older adult individuals were suffering fractures in the past, but it is more likely that older individuals may not have sought hospital care for fractures due to decreased mobility and senescence.

The inconsistent differentiation of leg and arm bones is a distinct challenge of working with historical hospital admission registers. The minute detail concerning fracture locations that can be observed in skeletal material is impossible to match in the hospital admission records. “Leg” and “arm” fractures could each refer to three different bones. It is possible that hospital clerks who were doing the register recording were working from physicians’ and surgeons’ case notes and from subscribers’ petitions

(Risse, 1986). Petition forms typically recorded more detail concerning the payment due for treatment than the reason for treatment (Figure 5.7).

Figure 5.7 Petition for William Miller to be admitted to Guy's Hospital, 26 June 1800



6/1800

To the Worſhipful the Preſident, Treaſurer, and Governors of the Hoſpital, founded at the ſole Coſts and Charges of THOMAS GUY, Eſq;

The humble Petition of Willm Miller
One of the Casual Poor of the Pariſh of St Georges Southwark

SHEWETH,

THAT your Petitioner is afflicted with a Fractured arm and being in low Circumſtances, and deſtitute of Friends, whereby to obtain a Cure, moſt humbly deſires your Worſhips would be pleaſed to admit into the ſaid Hoſpital.

And, as in Duty bound, ſhall ever pray.

We, the Church-Wardens and Overſeers of the Poor of the Pariſh above-mentioned, do hereby promiſe and agree for Ourſelves and our Succeſſors, to and with the GOVERNORS of the ſaid Hoſpital, that if they ſhall pleaſe to admit the ſaid Petitioner, We will Supply with clean Body-Linen every Week, and We will be Security for the Payment of Four-pence a Day for the Maintenance of of which We promiſe to advance before hand, by Way of Depoſit, Nine Shillings and Four-pence on the Day of Admiſſion for the firſt Month, and ſo continue to advance the like Sum of Nine Shillings and Four-pence on the firſt of every ſucceſſive Twenty-eight Days, ſo long as ſhall be continued in the ſaid Hoſpital, and will receive when ſhall be diſcharged from thence; and if ſhall die there, We will forthwith, upon our receiving Notice thereof, take away Body, or pay the Fees for Burial to the Steward of the ſaid Hoſpital for the Time being, according to the Uſage in that Behalf. Witneſs our Hands, this 26 Day of June 1800.

Witneſs Thos Stenton

Note, The Signatures of the Officers to be atteſted by the Beadle of the Pariſh, or by a ſubſtantial Inhabitant where there is none.

Church-Wardens,
OR
Overſeers.

*** *The Depoſits to be paid at the Hoſpital, or otherwiſe the* Meſſenger *to be paid* One Shilling *who ſhall be ſent for them.*

Accident

Admitted 26 June 1800
Discharged 13 Augt
Due for 48 days — 0 16
Admission fee 2/6 — 0 2 6
0 18 6

(Southwark Local Studies Library, Ref. 5929 and 5930 (1776-1811))

The lack of data on fracture location makes comparison between the historical and contemporary clinical records difficult. Donaldson et al. (1990), using outpatient records and employing record linkage to inpatient data in Leicester, UK, found that femoral neck fractures in females were the second most frequently occurring trauma in all age groups, whereas in males it was the tenth most common fracture site. This level of detail is not available in the historical records due to the relatively sparse level of detail recorded and the inability to conclusively link records.

The fibular fractures in the male skeletal sample were spread between the MA and OA age categories, with 5/21 (23.8%) in the MA1 category, 7/21 (33.3%) in the MA2 group, and 7/21 (33.3%) in the OA category (Table 5.3). Table 5.6 summarizes the locations of the fibular fractures found in the male skeletal sample. In order to compare the findings with clinical literature, the fractures are organized according to categories of fibular head/neck, diaphysis, and distal end/malleolus rather than into distal, medial, and proximal thirds as found in Table A.1. Fractures to the fibular shaft or diaphysis were the most common location; these fractures are generally caused by direct blows to the fibula, or indirectly through rotation of the foot (Trafton, 1992). Indirect force often causes fractures to the distal fibular shaft, just above the distal tibiofibular joint. Seven out of 13 (53.8%) of the diaphyseal fibular fractures were located on the distal fibular shaft. Benjamin Brodie, after visiting Dr. John Hunter's anatomical collection, noted "if the fibula is fractured alone, I suspect that it is most commonly fractured near the lower extremity" (RCS, MS0470, n.p.). A male individual suffering a fibular fracture spent, on average, 47.8 days recovering in hospital (data drawn from the Royal London, Middlesex, and Guy's) (Appendix C, Table C.13).

The fibula's anatomical position makes it prone to fracture due to direct force. Fibular fractures are most commonly found in athletes (e.g., Boden, Lohnes, Nunley, & Garrett, 1999; Slauterbeck, Shapiro, Liu, & Finerman, 1995), but also appear in older age groups due to osteoporotic changes (Hasselman, Vogt, Stone, Cauley, & Conti, 2003; Kelsey, Keegan, Prill, Quesenberry, & Sidney, 2006).

Table 5.7 Location of fibular fractures in male skeletal sample

Fractured Area	**Number Fractured n (%)***	**Tibia Affected n (%)+**
Head/Neck	2 (7.7)	0
Proximal diaphysis	4 (15.4)	2 (7.7)
Mesial diaphysis	3 (11.5)	0
Distal diaphysis	7 (26.9)	1 (3.8)
Lateral malleolus	10 (38.5)	3 (11.5)
Total	**26**	**6 (23.1)**

Values in parentheses are percentages. * = number of fibula with fracture in category / total number of fractured fibulae. + = number of corresponding tibiae fractured in anatomical area / number of fractured fibulae.

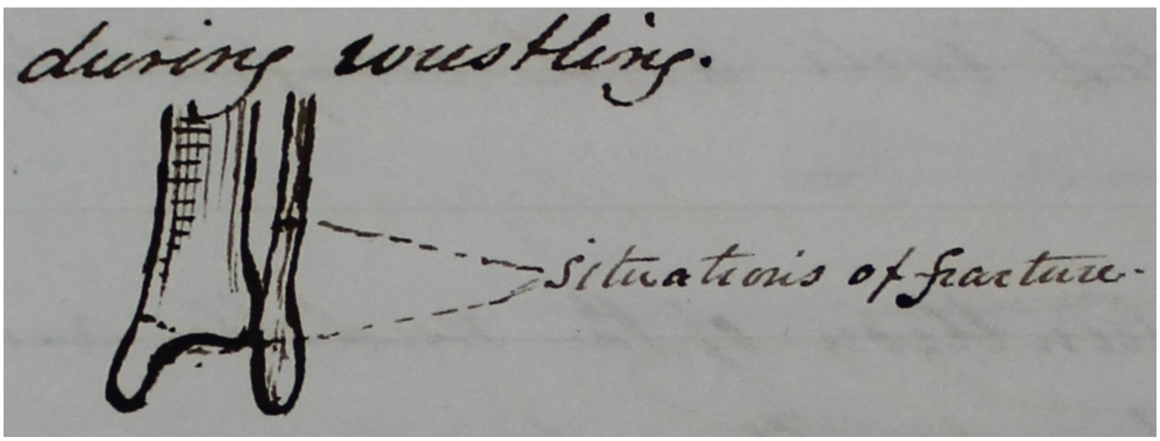
Fractures to the distal fibula and the malleolus are often associated with damage to the tibia and ankle in the clinical literature. The corresponding tibia displayed evidence of fracture in 4/17 (23.5%) of cases found in the male skeletal sample, and overall 6/26 (23.1%) of the fibular fractures displayed associated damage to the tibia (Table 5.7). Trafton, Bray, and Simpson (1992) describe pilon fractures of the tibia, which are usually found in the supramalleolar region, often with accompanying damage of the medial malleolus and articular surface. Fractures of this type result from falls from a height and motor vehicle accidents; Wedel and Galloway (2014) note that both shearing and compressive forces are at play in the production of pilon fractures. Individuals FAO90 1827, FAO90 2140, and FAO90 2152 displayed evidence of both distal fibular fractures and pilon fractures to the accompanying tibia (FAO90 2152 showed bilateral fractures), suggesting trauma to the ankle.

Fibular fractures were commonly described in surgical casebooks, particularly in concurrence with a tibial fracture. A surgical student at St. Thomas' describes the diagnosis and treatment of a woman with a broken fibula:

> A woman by a fall suppos'd she had broke her Leg, & was brought to the H und.r Mr Pauls care upon Examin: the Tibia was safe, but slideing [sic] A fing.r along the Fib & upon the part where she complain'd A fract was perceiv'd, He made A little Extens & there needed the Less because the Tib prevented its rideing & serv'd as A splint to it he then apply'd [Emy] defens A wet Compress & A long ROwler One broad pasteboard w.ch was laid against the bone, & bound it pritty tite [sic] with tapes & laid the Leg upon A pillow between 2 [Junks], A bridle & Cradle over all, she complain'd sometimes of pain, we look'd upont frequently & it remain'd in good posture therefore was not open'd off A fortnight or 3 weeks after, & was bound up as before with A fresh plaster, The next day she complain'd of pain & the foot Swell'd Mr Paul veiwd it but all seem'd well, A few days after he took A Rowler & rowl'd the foot & Leg & allow'd her to walk with Crutches, but yet it swell'd after walking, Mr Paul veiwd [sic] it again & told her nothing more coud [sic] be done time, & patience woud compleat [sic] the Cure
>
> Surgical Student at St. Thomas' Hospital (1725-1726)
> (KCL, GB 0100 TH/PP44, n.p.).

James Bosankoe, age 35, was brought to St. Bartholomew's Hospital with a fracture of the "int'l malleolus" and lower third of the fibula, due to a wrestling injury (St. B, MR 16/1, p. 93). The surgeon's sketch of the injury, which apparently healed, is shown in Figure 5.8. Another male, John Wilkins, age 40, entered St. Bartholomew's Hospital on February 2 with fractures of the lower third of the tibia and fibula. His "limb was united well and completely" and he left on March 17 (St. B, MR 16/1, p. 94). Vehicular accidents often resulted in fracture; William Toller, age 47, on July 8 was "running after an omnibus to overtake it and jump on the step, he missed and […] on the ground broke both bones to his own immediate knowledge" (St. B, MR 16/1, p. 95). He was deemed "ready to leave" on August 21, though the surgeon noted that there was "some little irregularity [in shape] from the upper portion overlapping and lying rather to the inner side of the upper portion" (St. B, MR 16/1, p. 95).

Figure 5.8 Surgeon's sketch of James Bosankoe's tibiofibular fracture



(St. B, MR 16/1, p. 93)

***5.3.3 Nasals/Skull/Head** – Males (Skeletal Rank 2, Admissions Rank 4), Females (Skeletal Rank 8, Admissions Rank 5)*

Following the ribs, the nasal bones were the most frequently fractured element in the male skeletal sample. Table 5.3 shows that the majority of individuals with nasal fractures were in the MA2 and OA categories (26/34 = 76.5%). The majority of individuals with one or more fractured nasal bones had multiple fractures (26/34 = 76.5%). Eighteen out of the 34 individuals with nasal fractures (52.9%) also had one or more rib fractures. Eight individuals (23.5%) had nasal fractures and one or more fractured metacarpals; four individuals (11.8%) had at least one fractured nasal bone, rib, and metacarpal.

Trauma to the face is most commonly focused on the central portion, the frontonasal region; nasal fractures are the most common of the facial fractures (Erdmann et al., 2008) and the third most commonly fractured bone in the body (Vipul, Kim, & Byrne, 2014). Facial fractures are usually not fatal (Bone, 1985; Wyatt, Squires, Norfolk, & Payne-James, 2011), but are commonly found along with other injuries to the thorax and cranium (Wedel & Galloway, 2014). Clinically, nasal fractures are common in cases of blunt force trauma such as motor vehicle accidents (e.g., Brasiliero & Passeri, 2006; Rogers, 1992; Shahim, Cameron, & McNeil, 2006), motorcycle and all-terrain vehicle accidents (Holmes, Koehler, McGwin, & Rue, 2004; Kraus, Rice, Peek-Asa, & McArthur, 2003; Shults, Wiles, Vajani, & Helmkamp, 2005), sports-related accidents (Marshall, Mueller, Kirby, & Yang, 2003; Perkins, Dayan, Sklarew, Hamilton, & Bussell, 2000; Reehal, 2010), interpersonal and domestic violence (Arosarena, Fritsch, Hsueh, Aynehchi, & Haug, 2009; Bakardjiev & Pechalova, 2007; Erdmann et al., 2008; Juarez & Hughes, 2014; Lee, 2009; Walker, 1997), and falls (Iida et al., 2003).

Bremke, Gedeon, Windfuhr, Werner, and Sesterhann (2009), in a retrospective German study, discovered a bimodal pattern in the ages at which individuals are most likely to suffer nasal fractures: there is a peak in males between 20 and 40 years old and a second peak among elderly individuals. The peak in ages found in the skeletal sample appears unimodal; however, since all the observed nasal fractures were acquired antemortem it is possible that the male individuals with nasal fractures who died in the MA2 and OA groups suffered the fractures at a younger age. Nasal fractures caused male individuals to stay in hospital (data drawn from the Royal London and Guy's; Appendix C, Table C.13) for an average of 12 days.

The cranium is the fifth most frequently fractured element in the male archival dataset (n = 70) and the fourth most frequently fractured in the female admissions dataset (n = 23) (Table 5.2). As displayed in Table C.15, 44.4% of skull/head fractures from the Royal London and the Middlesex hospitals proved to be fatal injuries in the male sample. The lack of detail in the hospital admission records makes an examination of cranial fractures difficult since head injuries may present in a variety of manners (e.g., linear, diastatic, depressed, comminuted, or stellate (e.g., Gurdjian, 1975; Heary, Hunt, Krieger, Schulder, & Vaid, 1993; Kroman, Tress, & Porta, 2011; Leventhal, Thomas, Rosenfeld, & Markowitz, 1993; Rogers, 1992)) and occur due to a wide variety of factors. Assaults, falls, and motor vehicle accidents are the most frequent clinical causes of cranial injuries in adults (Allareddy, Allareddy, & Nalliah, 2011; Hassan, Kelany, Emara, & Amer, 2010; Hwang & You, 2010). The cranium is exposed and vulnerable; it is heavily influenced by acceleration and deceleration due to its position atop the less robust neck (Wedel & Galloway, 2014) and therefore the force acting upon the cranium in a fall or motor vehicle accident may be more than the force experienced by the rest of the body. The cranial vault bones fracture most frequently in the following order: parietal, temporal, occipital, and frontal (Cooper &

Golfinos, 2000) due to their anatomical position and relative outer and inner table thickness.

The archival records describe individuals entering hospital with cranial fractures due to accidental falls, blunt force trauma due to falling objects, motor vehicle accidents (e.g., falling from a stage coach, having a stage coach roll over an individual's skull), and assaults. Once in hospital, male individuals stayed for an average of 56 days (based on data from all four hospitals) (Appendix C, Table C.13). Similar to the torso group, there was no significant linear correlation of the average number of male individuals admitted to the Middlesex for fractures of the cranial region over time (Appendix C, Figure C.1).

The skull fractures described in the historical record are most often devastating injuries, resulting in copious bleeding and patient insensibility. John West, age 78, entered St. George's Hospital on 5 April 1821 under the supervision of Benjamin Brodie after a cranial injury:

> About an hour before his admission he was thrown from off a stage coach and pitched upon his head – he was picked up immediately but was found quite insensible. As soon as, the pulse had got a surgeon bled him but I do not know to how much – he was brought into St Georges about 9 oClock. Insensible, pupils dilated; but he was very [unmanageable], flinging about his arms & legs in every direction

(RCS, MS0470 62, 1820-1860).

Brodie attempts to trephine the wound, but to no avail; John West dies the same day.

5.3.4 Metacarpal 1 *– Males (Skeletal Rank 3)*

The majority of the first metacarpal (MC1) fractures observed in the male skeletal sample were found in individuals in the MA2 (9/25 = 36.0%) and OA categories (13/25 = 52.0%) (Table 5.3). This pattern was similar to that found for the rib and nasal fractures in male individuals. Table 5.8 displays the locations of all the metacarpal fractures from the male skeletal sample. The most common location for metacarpal fractures found in this skeletal sample was the base; Jupiter and Belsky (1992) note that these generally result from an insult to the carpometacarpal joint. The hospital admission records did not differentiate between the different metacarpals or fingers when admitting an individual; therefore the average length of the stay for males of 21.8 days is based upon admissions for both hand and metacarpal fractures (Appendix C, Table C.13). When the data for the male hand group were charted, there was a weak negative linear correlation for a fall in hand fracture frequency (Appendix C, Figure C.7) though this was based upon a small sample of hospital admissions due to hand, wrist, and/or metacarpal fracture.

Table 5.8 Location of metacarpal fractures in male skeletal sample

Area	**MC1 n (%)**	**MC2 n (%)**	**MC3 n (%)**	**MC4 n (%)**	**MC5 n (%)**
Base	21 (80.8)	1 (33.3)	4 (57.1)	2 (100.0)	3 (30.0)
Shaft	4 (15.4)	1 (33.3)	3 (42.9)	0	5 (50.0)
Neck	0	1 (33.3)	0	0	1 (10.0)
Head	1 (3.8)	0	0	0	1 (10.0)
Total	**26**	**3**	**7**	**2**	**10**

MC = metacarpal. Values in parentheses are percentages. Number of metacarpal fractures in anatomical area / total number of metacarpal fractures by bone.

Fractures to the first metacarpal, of which there were 26 (in 25 individuals, one male individual had bilateral first metacarpal fractures) in the male skeletal sample, occur most commonly due to falls, punches, and direct blows (Lowdon, 1986; Rogers, 1992; Watson-Jones, 1941). Clinically, approximately one-third of first metacarpal fractures are known as Bennett's fractures. These fractures "involve the proximal articular surface and are characterized by cleavage of the inner side of the proximal base adjacent to the articulation with the wrist bones" (Wedel & Galloway, 2014, p. 238). These occur when an individual contacts a surface with a closed fist, causing hyperextension or hyperabduction of the thumb (Wedel & Galloway, 2014). Pelligrini (1988) notes that males outnumber females 10:1 for these fractures and they most commonly occur in the individual's dominant hand. In the skeletal sample 14/26 (53.8%) of the MC1 fractures were Bennett's fractures. The overall prevalence of Bennett's fractures out of the total metacarpal fracture sample (14/48 = 29.2%) is significantly lower ($p < 0.05$) than that observed by Brickley and Smith (2006), who found 14/16 (87.5%) of the observed metacarpal fractures were Bennett's fractures. The difference between these samples may relate to the manner of punching employed by these individuals. As detailed in Brickley and Smith (2006, p. 174), the position of the fist (horizontal or vertical) affects which bones of the hand are most likely to fracture.

In the male skeletal sample there were 10 metacarpal five fractures. Fractures to the metacarpal shaft and/or neck (most commonly in the fifth metacarpal) are often referred to in the clinical and palaeopathological literature as "Boxer's fractures" (McKerrell, Bowen, Johnston, & Zondervan, 1987; Salter, 1999; Wyatt, Illingworth, Clancy, Munro & Robertson, 2004). Ironically, in contemporary populations these rarely occur among professional fighters (who are much more likely to fracture the second or third metacarpal (Judd, 2002b; Jupiter & Belsky, 1992)), but most commonly occur due to inaccurate or badly thrown punches (Walsh, 2004).

Hand and finger bones are “particularly vulnerable in humans” (Wedel & Galloway, 2014, p. 235) due to the reduced muscle mass surrounding the bones. This reduction of muscle mass allows for finer manipulation of tools and objects, but also exposes the hand and finger bones to risk of fracture, be it from moving tools, blocking blows, or catching the body weight during a fall (Wedel & Galloway, 2014). North American clinical studies have described metacarpal fractures as common; they comprise 20-40% of all hand fractures (Ashkenaze & Ruby, 1992; Hunter & Cowan, 1970), while metacarpal and phalangeal fractures comprise 10% of all fractures, of which over 50% are work-related injuries (Egol, Kovak, & Zuckerman, 2010). Buhr & Cooke (1959) note that metacarpal fractures are particularly common in young adult men, though the authors do not provide a behavioural explanation.

5.3.5 Thoracic vertebrae *– Males (Skeletal Rank 4), Females (Skeletal Rank 3)*

The number of individuals with fractures to the thoracic vertebrae in the male skeletal differ little among the age categories; there are three individuals in the MA1 category (3/13 = 23.1%), four individuals in the MA2 group (4/13 = 30.8%), and five individuals in the OA category (5/13 = 38.5%) (Table 5.3). Two of the five female individuals with fractures to the thoracic vertebrae could be assigned an age category, and they were both older adults. The lumbar fractures present in the skeletal sample will be referred to in this discussion since the thoracolumbar spine reacts to forces as a continuous unit. Table 5.9 compares the relative frequency of fracture locations on the thoracic vertebrae by sex. There were no vertebrae with more than one fracture. The vertebral body was the most commonly fractured region in both the male (79.2%) and female (71.4%) skeletal samples.

Table 5.9 Locations of thoracic vertebral fractures observed in skeletal sample by sex

	Number fractured	
Area of Vertebra	Males n (%)	Females n (%)
Body	19 (79.2)	5 (71.4)
Spinous process	4 (16.7)	0
Articular facet	1 (4.2)	0
Transverse process	0	1 (14.3)
Lamina	0	1 (14.3)
Total	**24**	**7**

Values in parentheses are percentages. Number of vertebral fractures in anatomical area / total number of fractured thoracic vertebrae.

Spinal fractures usually occur due to indirect trauma involving "excessive flexion, extension, compression, rotation, shearing action or a combination of these movements (Wedel & Galloway, 2014, p. 163; Bucholz, 1994; Rogers, 1992). Falls (average 3m in height) and motor vehicle accidents are the most common causes of thoracic spine fractures (e.g., Cooper et al., 1992; Hsu et al., 2003; Meldon & Moettus, 1995; O'Connor & Walsham, 2009). Direct force applied to the spine may also cause a fracture, but this cause is less common clinically (Wedel & Galloway, 2014). Mid-thoracic vertebrae become increasingly at risk of fracture with increased age. Individuals suffering age-related spinal fractures often also experience hip and forearm fractures (Cummings & Melton, 2002). In the skeletal sample, only one individual (PAY05 832), an old adult male, displayed a suite of fractures that appear to be age-related. This individual had a compression fracture of the first lumbar vertebra and evidence of a healed Colles' fracture to the left radius. The left ulna was also affected, showing a possible healed fracture of the styloid process in addition to osteophytic expansion of the joint surface and secondary osteoarthritis.

Clinically, vertebral trauma is most commonly reported in middle-aged males; these fractures and dislocations are caused by falls and sports-related injuries (Gulati, Aggarwal, Kumar, & Agarwal, 2012; Hasler et al., 2011; Hu, Mustard, & Burns 1996). In contrast to the results found in the skeletal sample, Liu et al. (2012) in China and Hu, Mustard, & Burns (1996) in Canada discovered that, in descending order, the lumbar, thoracic, and cervical vertebrae were most affected by injury.

Compression fractures are clinically described as causing a shortening (or wedging) of vertebral body height (Ferguson & Allen, 1984) and the majority of thoracic fractures are due to compression (e.g., Denis, 1984; Eismont, Garfin, & Abitol, 1994; Ferguson & Allen, 1984; Kricun & Kricun, 1992; Levine & Edwards, 1992; Rogers, 1992) and often affect multiple thoracic vertebrae. The majority of thoracic vertebral fractures found in the skeletal sample for both males and females were vertebral body fractures (males 19/24 = 79.2%, females 5/7 = 71.4%). Of the body fractures, 18/19 (94.7%) in males and 5/5 (100%) in females were compression fractures. Leucht, Fischer, Muhr, & Mueller (2009) found that high-energy falls most commonly resulted in multilevel compression fractures. Compression fractures occur more often in women than in men and usually do not appear in individuals under the age of 50 (Galloway, Stini, Fox, & Stein, 1990). The elderly, especially women, are also at increased risk of spinal fracture, particularly compression fractures (Bouxsein et al., 2006; Cooper, O'Neill, & Silman, 1993; Old & Calvert, 2004; Shin et al., 2012), due to loss of bone mass (Cook, Guyatt, Adachi, Lauren, & Epstein, 1993; Patel, Skingle, Campbell, Crisp, & Boyle, 1991; Sinaki, 2003). There is also clinical evidence that individuals enduring an epileptic fit may unknowingly suffer vertebral compression fractures (Aboukasm & Smith, 1997; Vasconcelos, 1973).

Avulsion fractures generally occur due to indirect muscle tension and direct trauma; avulsion fractures to the vertebral endplates are of particular concern for adolescent individuals (Levine & Edwards, 1992). Rotational forces may cause damage to the articular facets and laminae; spinous process fractures due to rotational forces may occur when the body rotates relative to the cranium and neck (Rogers, 1992). The spinous processes or laminae are likely to be fractured by hyperextension (Eismont et al., 1994; Evans, 1982). Articular facet fractures are uncommon (Levine & Edwards, 1992), but may sometimes occur due to extension and posterior shear injuries.

It is likely that the spinal fractures observed in the skeletal sample are less severe than the type of spinal fractures described in the hospital casebooks, which all appear to be dramatic examples of injury, as described below. The spinal fractures that appear in the skeletal sample were all suffered antemortem. Clinically, it is estimated that approximately 65% of spinal fractures go undiagnosed (Lentle et al., 2007; see also Delmas et al., 2005); often there are no symptoms, in other cases individuals experience generalized back pain, but the pain is not differentiated from that of a muscle strain or sprain. It is possible, therefore, that the individuals with antemortem thoracic vertebral fractures felt no pain, or felt back pain but did not require hospitalization. This would explain why thoracic vertebral fractures are among the most common fractures for both males and females in the skeletal sample, but spine fractures rank tenth for reasons for admission in the Middlesex and Royal London admission records (Appendix C, Table C.6)

Fractures to the spine or back that appeared in the Royal London and Middlesex admittance records were all fatal, with individuals lingering from between three and 19 days before death. The individuals admitted to St. Thomas' and Guy's Hospitals with spinal fractures who were eventually discharged had an average convalescence period of 234.7 days (Appendix C, Table C.13), demonstrating the severity of the injury. On June 23, 1827, James Barnett fell from a haystack about 10 feet high, fracturing his spine and sternum. He spent five restless days in St. George's Hospital before dying of his injuries. Brodie noted after autopsy that the "spinal cord was seen stretched across an angle formed by the upper portion of bone being thrown forward" (RCS, MS0470 51, p. 92). Thomas Gardner, age 61, fatally fractured his back by falling onto a curbstone and died at St. Bartholomew's Hospital (St. B, MR 14/14, n.p.). Henry Fine, a sailor, slipped while descending a staircase, but was "unable to recover himself on account of a recent injury to left hand," the result being that "he fell backwards down two steps and hit the upper part of his neck on the edge of the step" (St. B, MR 16/1, p. 157). Though he remained "quite sensible" and was able "to drink and speak plain till a short time previous to his death" (St. B, MR 16/1, p. 157), he still passed away. Autopsy revealed a fracture to the body and neural arch of the sixth cervical vertebra as well as the articular facets of the fifth cervical vertebra. Other individuals suffered fatal spinal fractures due to being thrown from horses (St. B, MR 16/1, p. 166), falling through a trap door onto their backs (St. B, MR 16/1, p. 154) or being knocked down by a coach (St. B, MR 16/1, p. 168).

5.3.6 Radius and Ulna *– Males ((Skeletal: Radius Rank 8, Ulna Rank 15); Admissions (Arm Group) Rank 2), Females (Skeletal: Radius Rank 2, Ulna Rank 4; Admissions (Arm Group) Rank 2)*

The majority (12/18 = 66.7%) of radial fractures in the female skeletal sample were found in the OA category. As shown in Table 5.11, of the 18 radial fractures, 16 of them (88.9%) were located on the distal third of the bone and eight were likely Colles' fractures. Of the eight individuals with Colles' fractures, seven were placed in the old age category, while I was unable to age the eighth adult (Table 5.3). Half of the individuals with fractured ulnae (3/6 = 50%) were in the OA age category. Bartonicek et al. (2008), in a Czech study, found that the average age of individuals with a distal radial fracture was 59.

Table 5.10 Summary of fracture location of female forearm skeletal elements

Element	**Element Region**		
	Proximal n (%)	Medial n (%)	Distal n (%)
Radius	1/18 (5.6)	1/18 (5.6)	16/18 (88.9)
Ulna	3/6 (50.0)	1/6 (16.7)	2/6 (33.3)

Values in parentheses are percentages. Number of fractured elements in category / total number of fractured female radii or ulnae.

Radial fractures most commonly occur due to falls onto an outstretched hand (Chung & Spilson, 2001; Mikić, 1975), though some occur due to a direct blow (Armstrong, Joughin, & Clarke, 1994; Hughston, 1957). The most frequently fractured part of the radius is the distal third of the diaphysis, particularly in the elderly (Bauer, 1960) when risk factors such as osteoporosis and balance problems rise in prevalence. In fact, Alffram and Bauer (1962) determined that approximately 75% of all forearm fractures are distal radial or ulnar fractures. Males usually have more radial fractures until age 45, when female prevalence rises and the force required to fracture the radius decreases (Alffram & Bauer, 1962; Buhr & Cooke, 1959; Vogt et al., 2002). Impact fractures, such as Colles' fractures (Alffram & Bauer, 1962; Dóczi & Renner, 1994) and Smith's fractures (Dóczi & Renner, 1994) are most common in older women over 45 years of age. Avulsion fractures to the styloid process are also possible and may be accompanied by wrist dislocation (Watson-Jones, 1941).

There were three radial fractures that were accompanied by ulnar fractures. First, individual PAY05 696 displayed a Colles' fracture and an ununited fracture of the ulnar styloid process to the left radius and ulna. Second, individual FAO90 2308 had fractures to the proximal right radius and ulna, located at the radial head and olecranon. Finally, individual NLB91 169 displayed healed midshaft fractures to the right radius and ulna. The remodeled calluses emanating from the sites of these fractures appear to show an articulation between the radius and ulna, suggesting that there was movement in the elements during healing (Figure 5.9).

Figure 5.9 Radius and ulna of individual NLB91 169 with detail of callus articulation on the ulna

The ulna is vulnerable to fracturing due to direct force because it is generally the first bone to make contact with an assailant and is exposed when individuals attempt to catch themselves during a fall. The proximal ulna is protected by little soft tissue and a fracture is likely to occur during falls if the arm is flexed and if the olecranon suffers a direct blow (Rogers, 1992). Distal ulnar fractures, such as fractures of the styloid process, may be produced with extreme force and are usually associated with motor vehicle accidents or falls from heights (Wedel & Galloway, 2014).

Simple fractures to the bones of the forearm are described in the hospital surgeons' casebooks. These closed fractures are dealt with seemingly without alarm through reduction and immobilization with rollers or arm board/splints (St. B, MR 16/1, p. 49). James Knowles, age 23, arrived at St. Bartholomew's Hospital,

> having fractured the same day his right radius and ulna about the middle. The extremities of the upper and lower portions overlapped, the lower portion when the arm was placed prone was down in a direction from the lower extremity of the radius to the coronoid process of the ulna. Atttempts at

> reduction produced extreme pain, the arm was therefore laid on a splint in its unnatural position, and kept covered with a poultice: the slightest degree of extension was made each day and what was thus gained was secured by the application of broad strapping. Under this treatment the arm was brought into its proper position in 14 days and united favorably and without delay - .
> (St. B, MR 16/1, p. 51)

Surgeon Benjamin Brodie's advice is quoted in a casebook from St. Bartholomew's concerning radial fractures, that one must "always [treat] a severe sprain of the wrist as a fracture of the lower part of the radius" (St. B, MR 16/1, p. 55), indicating that surgeons were aware of the similar presentation of fractures and severe sprains.

One female individual was admitted to Guy's Hospital with a radial fracture; she spent 19 days convalescing (Appendix C, Table C.13).

Arm fractures ranked as second most frequent for the males (n = 144) and females (n = 81) in the admission records dataset (Table 5.2). There were individuals admitted to the Royal London and Middlesex hospitals with humeral (males, n = 2; females, n = 3), radial (males, n = 4; females, n = 3), and ulnar/olecranon (males, n = 5; females, n = 3) fractures (Appendix C, Table C.6). It is unclear how these fractures relate to the overall category of "Fractured arm" that was so frequently recorded in the hospital registers.

5.3.7 ***Proximal manual phalanges*** *– Males (Skeletal Rank 5), Females (Skeletal Rank 5)*

Fractures to the proximal manual phalanges in males were most common in the MA2 (6/15 = 40%) and OA (6/15 = 40%) age categories (Table 5.3). There were a total of 15 fractured proximal manual phalanges in 15 individuals in the male sample. In the female skeletal sample there were a total of five fractured proximal manual phalanges in three individuals. Fractures to the proximal phalanges most frequently appeared as isolated injuries; 10/15 (66.6%) of proximal phalanx fractures in the males and 2/3 (66.6%) in the females appeared as the only fracture to the recovered hand and wrist bones. In the other 1/3 (33.3%) of cases, the antemortem proximal phalanx fracture was accompanied by antemortem fractures to one or more metacarpals, suggesting that the fractures occurred in a single incident.

Until age 60 and above, men outnumber women 2:1 in rates of phalangeal fractures, with a peak in the 40-49 age group of 5.4:1, according to a 23-year retrospective study conducted at the Groningen University Hospital in the Netherlands (De Jonge, Kingma, van der Lei, & Klasen, 1994). Phalanges are at a high risk for avulsion and comminuted fractures since fingers may become caught in machinery or otherwise crushed. Hand injuries (lacerations, crushes, or fractures) are the leading occupational injury in the United States (Sorock et al., 2001). Occupational hand injuries have been associated with undertaking a non-typical work task, the use of defective equipment, and being under the age of 25 (Hertz & Emmett, 1986). Sorock, Smith, & Hall (1993) and Sorock et al. (2001) add being distracted or rushed, feeling unwell, working overtime, and wearing gloves as further factors influencing hand and phalanx injuries. Fractures to the phalanges may also result from sports-related injuries and falls (Wedel & Galloway, 2014). Indirect forces (such as the finger being twisted) can result in spiral shaft fractures (Bowman & Simon, 1993) and the anatomical location of the proximal phalanx is noted as being particularly unstable (Widgerow & Ladas, 2001).

In the hospital admission records finger and thumb fractures rank in ninth and thirteenth places respectively in terms of elements most frequently fractured in males

(Appendix C, Table C.6). In the female hospital admission sample there is a single case of an individual being admitted with a hand fracture. It is likely that small-scale fractures, such as those of the phalanges, could be treated at home and did not require a hospital stay except in extraordinary circumstances. The average length of stay in hospital for a fractured finger was 47.1 days for males and 42.3 days for females (Appendix C, C.13), hospitalizations that certainly suggest complicated injuries. Of the individuals who did require hospitalization, extenuating circumstances such as a compound injury might be present. David Murphy, age 33, was admitted to St. Bartholomew's with a compound luxated thumb, which he had suffered

> upon his left hand while descending a stair-case…in a state of drunkenness, and thus occasioned a luxation of the second phalanx of the thumb backwards with protrusion of the distal end of the first phalanx through the integuments (William Lawrence, St. B, MR 8, n.p.).

David Murphy was threatened with amputation and the physicians feared he was suffering from tetanus, but he eventually recovered through treatments of "two dozen leeches to the root of the thumb," laudanum, saline solution, a bread poultice, and rest (St. B, MR 8, n.p.).

***5.3.8 Navicular** – Females (Skeletal Rank 5)*

There were five navicular fractures in four females in the skeletal sample. No navicular fractures were found in the male skeletal sample. Half of the fractures were found in individuals in the MA2 category (Table 5.3). There was no other evidence of trauma in the skeletons of the four female individuals with navicular fractures. Clinically, navicular fractures are associated with physically demanding activities such as running and track and field athletics and the literature suggests that young athletes are at higher risk for stress fractures of the navicular (Georgen, Venn-Watson, Rossman, Resnick, & Gerber, 1981; Khan, Fuller, Brukner, Kearney, & Burry, 1992; Khan et al., 1994; Kiss, Khan, & Fuller, 1993; Saxena, Fullem, & Hannaford, 2000). Navicular stress fractures are a common athletic injury due to repetitive stress associated with running or marching (Hunter, 1981; Torg et al., 1982) or twisting of the foot while walking or running (Eichenholtz & Levine, 1964). Heckman (1984) noted that these stress fractures are often oriented sagittally. Other types of navicular fracture may occur due to avulsion or high-energy impacts, such as motor vehicle accidents or falls from a height (Sangeorzan, Benirschke, Moshe, Mayo, & Hansen, 1989).

Women are at increased risk for stress fractures (Bennell, Malcolm, Thomas, Wark, & Brukner, 1996; Chen, Tenforde, & Fredericson, 2013). Clinicians have proposed the 'female athlete triad' of risk factors including low energy availability, amenorrhoea, and decreased bone mineral density as reasons for this increased risk (Hoch et al., 2009; Nattiv et al., 2007). Military studies have shown that female recruits have a higher incidence of stress fractures than male recruits (Smith, 1992; Wentz, Liu, Haymes, & Ilich, 2011). The four female individuals with navicular fractures may have been undertaking strenuous physical activity which, in combination with the increased age of three of the four (75%) individuals (Table 5.3) and accompanied bone loss, caused the hairline stress fractures to occur.

Clinically, the diagnoses of navicular fractures have been described as "sometimes obvious, frequently difficult, occasionally elusive" (Eichenholtz & Levine, 1964, p. 142). The authors outline several case studies in which an individual fractured the navicular, but their physician did not initially diagnose the injury, even after radiographs were taken. They conclude that navicular fractures still prove difficult to diagnose and that the fracture "frequently presents itself as a minor injury which leaves the patient with a major problem—a painful foot" (Eichenholtz & Levine, 1964, p. 151). The difficulty of diagnosis – and the fact that x-rays were not discovered until 1895, well after the temporal period under investigation – suggests that navicular fractures may be masquerading as hospital admissions for "sore foot" or "bruised foot."

Two female individuals were admitted to the Royal London and Middlesex Hospitals for foot fractures and two for ankle fractures. On average, females spent 47.3 days in hospital for an ankle fracture and 21.3 for a foot fracture (Appendix C, Table C.13). The navicular fractures discovered in the skeletal sample were all antemortem and all appeared to be well remodeled. The fractures manifest as hairline cracks, all showing evidence of remodeling. In contrast, the ankle fractures that are described in the surgical records are dramatic traumatic events. For example, a fatal ankle fracture is described:

> Fracture of the internal and external Malleoli of the right leg into the ankle Joint – Fracture of the navicular and one cuneiform bone with […] of the Joint of the left leg. Laceration of outer tibial artery on the dorsum of the foot, with external wound – Death –
>
> (St. B, MR 16/4 Vol. 1, p. 148)

This was the fate of Thomas Norris, age 38, who suffered an ankle fracture due to "the fall of an iron safe on his ankles, which he was lifting into a wagon." Despite the small size of the wound his "trousers at the lower part, boots and stockings were soaked to a considerable degree with blood" (St. B, MR 16/4 Vol. 1, p. 148). This type of extreme trauma does not match the minor stress fractures to the naviculars discovered in the skeletal sample.

5.3.9 Knee/Patella *– Females (Skeletal Rank 7; Admissions Rank 3)*

Fractures to the knee and/or patella were the fourth most frequent reason (n = 43) for female admission to the Royal London and Middlesex hospitals (Table 5.2). The lack of detail available in the archival records regarding injury location, as with the cranial fractures, makes this a difficult category to interrogate. A severe knee injury such as a tear to the cruciate ligaments may have presented and been treated (i.e., rollered or splinted) as a fracture. It is possible that individuals with cases of bursitis, or 'housemaid's knee', were admitted to hospital and categorized as fracture cases since bursitis can cause symptoms of swelling, redness, and pain and arise from repetitive injury or from receiving a blow to the knee. Bursitis is an occupational injury that may be caused by repetitive kneeling (Thun et al., 1987; Kivimäki, 1992); it is known colloquially as 'beat knee' in reference to British low seam coalminers (Hunter, 1978). Female individuals employed as domestic servants were likely to have been undertaking cleaning tasks that involved prolonged periods of kneeling.

The majority (5/6 = 83.3%) of the knee/patellar fractures in the Royal London Hospital female admissions are in the MA2 or OA age categories (Table 5.4, Figure 5.2). The sample size is small, but there is a suggestion that the knee fractures are more commonly associated with female individuals who are middle-aged or older (Table 5.4).

Kanis et al. (2001) posited that many fractures in the knee area may be related to osteoporosis; their supposition is supported by Court-Brown and Caesar (2006). Knee or patella fractures, on average, resulted in a hospital stay of 66.5 days for female individuals (based upon data from all four hospitals) (Appendix C, Table C.13). As referenced above, the number of female individuals admitted to hospital in the leg fracture category increased over time.

Table 5.11 Age distribution of individuals with patella fractures in skeletal sample

Age Category	**Males n (%)**	**Females n (%)**
YA (18-25)	0	0
MA1 (26-35)	1 (16.7)	0
MA 2 (36-45)	2 (33.3)	1 (50.0)
OA (46+)	3 (50.0)	1 (50.0)
Total	**6**	**2**

Values in parentheses are percentages. Number of individuals with fractured patellae in age category / total number of individuals with fractured patellae in sex category.

In the skeletal sample there were a total of 10 patella fractures in 8 individuals. One female and one male had bilateral patella fractures. Despite the small sample size, the data in Table 5.11 suggest that patellar fractures may be age-related; no patella fractures were observed in the YA category and only one in the MA1 category. More patella fractures were observed in the male skeletal sample than the female sample; this may be reflecting the overall male bias of the skeletal sample since the difference was not statistically significant. In the admissions dataset the number of hospital admissions for knee/patella fractures was statistically significantly higher in the female dataset (Appendix C, Table C.6). The difference between the skeletal and admission datasets is clear in this example – the two datasets provide opposing results concerning the relative prevalence of knee/patella injuries between the sexes.

Clinical research suggests that females are more prone to knee injuries than males. Female athletes are 1.5 – 3.5 times more likely to suffer a stress fracture than male athletes (Brunet, Cook, Brinker, & Dickinson, 1990; Zeni, Street, Dempsey, & Staton, 2000). The recorded higher incidence of anterior cruciate ligament injuries in females has been hypothesized to be the indirect result of hormone fluctuation (i.e., estrogen, progesterone, and relaxin) during the menstrual cycle. The hormone fluctuations "increase ligamentous laxity and decrease neuromuscular performance," resulting in decreased stability of the knee joint (Hewett, 2000, pp. 313-314; Wojtys, Huston, Boynton, Spindler, & Lindenfeld, 2002). The biomechanics of the female core and knee joint have also been investigated (Zazulak, Hewett, Reeves, Goldberg, & Cholewicki, 2007; Hewett et al., 2005), leading investigators to conclude that females have a biological suite of factors that puts them at increased risk of knee injury due to their decreased knee and hip flexion, greater use of the quadriceps, and greater knee valgus angles (e.g., Jacobs, Uhl, Mattacola, Shapiro, & Raynes, 2007; Malinzak, Colby, Kirkendall, Yu, & Garrett, 2001; McLean, Walker, & van der Bogert, 2005; Sigward & Powers, 2006; Pollard, Sigward, & Powers, 2007; Powers, 2010).

The etiology of patellar fractures in the "long" eighteenth century appears to be overexertion of the muscles surrounding the patella; two individuals were admitted to St. St. Bartholomew's with transverse fractures to the patella, apparently fractured "from muscular exertion" and "muscles Effort" (St. B., MR 16/1, p. 82). Indeed, the patella is recorded as:

> more frequently broken in a simple transverse direction by the action of the extensor muscles of the thigh, whilst the bone is placed in an unfavourable position on the end of the femur than broken by direct violence as from a fall on knee or a foreign body striking it
>
> (St. B, MR 16/1, p. 88).

The muscle action required to fracture the patella may be effected by "a person trying to save themselves from a fall," "the violent action of the extensor muscles of a person lying in bed in a convulsive fit," and even "occasionally by the common action of the muscles [when] dancing" (St. B., MR 16/1, p. 88).

The hospital admission sample is directly comparable to Guenter Risse's landmark study of the Royal Infirmary of Edinburgh (1986). Risse (1986) determined that between 1770 and 1800, 20.2% of all hospital admissions were categorized as surgical. These "surgical accidents" included infectious conditions, trauma, tumours, surgical procedures, and miscellaneous conditions such as animal bites and burns. Fractures were the most common surgical condition, comprising 23.4% of the sample (Risse, 1986, p. 157). There was differentiation between bruises, dislocations, fractures, sprains, and wounds in the Edinburgh register, similar to the Middlesex and Royal London hospital admission books. Fractures were labeled as simple or compound; the latter category was used if the fractured bone communicated with air through a flesh wound. Fractures of the leg and arms were most common, followed by the thigh and skull (Risse, 1986, p. 158), results that are similar to those observed at the Middlesex and Royal London hospitals. Men comprise almost 80% of cases of fracture at the Royal

Infirmary of Edinburgh (Risse, 1986, p. 158). In the Middlesex and Royal London records, male comprise 69.8% (Table 4.7; 1198 male/1717 total) of all cases of fracture.

5.4 SUMMARY

The crude prevalence comparison of anatomical categories for the skeletal dataset revealed that there was a statistically significant higher prevalence of fractures in the male group than the female group in the cranial, torso, leg, hand, and foot categories. Hospital admission records for the Royal London and Middlesex were compared using the same categories and there was a statistically significant higher proportion of cranial, torso, and hand fractures found in the male group compared to the female group. These differences were investigated by ranking the most frequently fractured elements observed in the skeletal sample (Males: ribs, nasals, first metacarpals, fibulae, thoracic vertebrae, proximal manual phalanges; Females: ribs, radii, thoracic vertebrae, ulnae, naviculars, proximal manual phalanges), as well as the top reasons for hospital admission (Males: leg/thigh/femur, arm, rib/ribs, skull/head, clavicle; Females: leg/thigh/femur, arm, knee/patella, rib/ribs, skull/head). The most common fractures were organized into age categories; it is clear that certain conditions, such as rib fractures in both sexes and radial fractures in females may be age-related.

Chapter 6.0 – RESULTS and DISCUSSION: Recidivism, Occupations, and Violence

6.1 INTRODUCTION

In this chapter I discuss possible causes of fractures, drawing upon the rich archival dataset available concerning medical practice in London during the "long" eighteenth century. The possibility of identifying individuals with multiple fractures and possible injury recidivists in the skeletal dataset is addressed with a view to examine interpersonal violence and fractures accumulated through the life course. I examine the possibility of identifying individuals with multiple fractures and those repeatedly fracturing the same element in the hospital admission records. I discuss the occupations of individuals recorded in the Royal London hospital admissions records in relation to fracture risk. Finally, I describe the presence of perimortem trauma in the skeletal dataset.

6.2 FRACTURE CAUSES

"ACCIDENTS – those frequent sources of *deep* and *lasting* Misery"
(Bosworth, 1813, p. iii).

Seeking to access and reconstruct the context of skeletal fractures requires examination of the proximate (mechanical) and ultimate (cultural) causes of the fracture (Lovell, 1997, 2008). Assigning or suggesting causes (e.g., accident, intentional injury, abuse) to antemortem fractures found in skeletons must be attempted carefully, drawing upon detailed descriptions and with attention to the patterning of fractures through the individual's skeleton. Jurmain (1999) counsels that assigning patterns of trauma to specific behaviours has many limitations; interpretations of the skeletal data in this study are made, therefore, with caution. Without specific contextual evidence the cause of a fracture is simply speculative (Jurmain, 1999; Jurmain & Bellifemine, 1997; Stirland, 1996; Wakely, 1997). Modern clinical data provide a framework in which to consider the skeletal evidence. According to clinical data for the United States, vehicular trauma is the leading mechanism of injury (Koval & Cooley, 2006), with falls as the second most common cause of injury.

Bioarchaeological studies frequently struggle with differentiating between accidental and intentional injuries; indeed, it is often impossible to unequivocally determine a fracture's cause. Accidents or intentional forces may result in fractures (e.g., Berryman & Haun, 1996; Greer & Williams, 1999). Sharp-force weapons may cause fractures (Knüsel, 2005; Novak, 2000) and contextual evidence of sharp-force weapon injuries provides a better foundation for interpretations of fractures resulting from intentional injury (Judd & Redfern, 2012; Jurmain et al., 2009).

Most fractures are due to accidental traumatic injury (Lovell, 2008). Falls onto an outstretched hand may be the clear mechanism of injury, but the falls themselves may be caused by accidents or intentional pushes (Osifo et al., 2010). Irregular terrain, hours of daylight, and climate have been noted as factors that may increase the risk of fracture (e.g., Alvrus, 1999; Jimenez-Brobeil et al., 2007; Judd, 2006; Kilgore et al., 1997). Many other factors influencing the risk of fracture due to falls have been investigated in the clinical literature, including: age (Berry & Miller, 2008; Cooper et al., 1992; Formiga et al., 2008), overall health (Berry & Miller, 2008; Cooper et al., 1992), prescription medications (Cooper et al., 1992; Formiga et al., 2008), footwear (Berry & Miller, 2008; Cooper et al., 1992; Keegan et al., 2004), time of day (Niino et al., 2003), handedness (Luetters et al., 2003), location (Formiga et al., 2008; Li et al., 2006; Niino et al., 2003), and the type of fall (Palvanen et al., 2000). Sociocultural factors such as occupation and technology have also been explored (Domett & Tayles, 2006; Judd & Roberts, 1999; Judd, 2006).

The surgeons' casebooks paint a picture of eighteenth-century London as a place fraught with hazards. Individuals described by the surgeons suffered fractures due to a variety of factors, such as:

falls,

> A woman fell down the Monument stairs, & broke her Leg, she was carried to a surgeon at the Bridge End, who perceiv'd she would prove A Charity patient he reduc'd the fract, & bound it up in an indifferent manner, intending next day to send her to the Hospitall [sic]
> (KCL, St. Thomas' Surgical Student, 1725, n.p.).

> Man of muscular and robust frame fell from a fire escape on his head the height of 60 feet, he was picked up quite insensible was brought immediately to the Hospital… No distinct depression of bone was observable, but a small quantity of blood oozed out of the line of fracture
> (KCL, St. Thomas' Surgical Student, 1725, n.p.).

> Thomas Wright a middle aged stout man, was climbing a ladder with a sack of beans on his back & had nearly arrived at the top, when the ladder gave way & he fell to the ground, from a height of ten of [sic] twelve feet, or more. He received in falling a very violent blow on his left cheek, as well as on other parts of his body; the blood flowed instantly in considerable quantities from his mouth & nostrils, and he was immediately conveyed to St George's hospital… The alveolar processes of the grinding teeth of the left side were completely broken off from the body of the bone
> (RCS, 1805, MS0470, p. 7).

falling objects,

> John Hughes …With Compound Fracture of the left thigh from a large woolsack falling on him off a waggon which knocked him down with great violence his leg being bent under him, it happened about an hour & ½ ago, he was brought here immediately a distance of 3 miles, much blood was lost on the way.
>
> (Benjamin Brodie, RCS, MS0470 51, p. 70)

inebriation,

> Wm. William [aet.] 45-50. A muscular, well made Welch [sic] forgeman. grossly intemperate in the use of beer of which he drank four gallons daily, coming up to London fell off a coach near Newbury June whilst asleep; the coach at the same tine was proceeding rapidly. – the force of the fall came chiefly on the middle of his arm… the case was considered as one of Fracture of the neck of the humerus
>
> (St. B, MR16/4 Vol. 1, p. 33).

collisions with motor vehicles,

> A woman was thrown down upon her Side by A Coach & the wheel ran over the contrary Leg & snapt [sic] the fibula A little below the knee
>
> (KCL, St. Thomas' Surgical Student, 1725, n.p.).

> A man [oet.] 63 dragged by a cart, one of the wheels passing over the pelvis… The crest of the ilium, the pubis and acetabulum all appeared to be fractured – A belt was fixed round the pelvis and a Desault's splint was applied. The limb united firmly of its natural length with some eversion –
>
> (St. B, MR16/4 Vol. 1, p. 111).

encounters with animals,

> An Elderly Man foddering his Cows, one of 'em kick'd his Leg & broke it he was brought to y.e H at 9 at Night
>
> (KCL, St. Thomas' Surgical Student, 1725, n.p.).

> Mary Wickam a mar.d Woman about 26 year of Age rec.ed a kick from a Horse in Smithfield and was brought in to the Hospital insensible. On examining her Head, there was a large fracture found on the left parietal Bone extend.ng some way upwards and downwards with some degree of depression.
>
> (Wellcome Library, 1781, MS 4337, p. 21).

blows from various objects,

> John Benfield… Broke his Left arm just below the insertion of the Deltoid from a blow with a whip and taking no care of it, allowed it merely to hang by his side for six days, when he was admitted into the Hospital.
> (St. B, MR16/4 Vol. 1, p. 36).

> Giles Beard – [age] 34. Jan 11. Fracture of left tibia at junction of middle and inferior 1/3, the skin was tucked in and blue at the situation of the fracture, partly pierced by the obliquity of the fracture
>
> Cause – blow from a wooden shoe
> (St. B, MR16/4 Vol. 1, p. 94).

engineering failures,

> James Sheppard… injured by the fall of a garden wall, broke down by water blocked up behind it on Tuesday. June. 29th. at 6. PM. –
>
> Died. 11. PM. same evening.
> Separation of left sacro iliac symphysis fracture of ossa pubis – simple fracture
> (St. B, MR16/4 Vol. 1, p. 55).

> Nicholas Glynn…. a stone staircase gave way with & he fell from a height of 10 or 12 ft one of the stones fell across the thighs and fractured them both simply
> (Benjamin Brodie, RCS, MS0470 49, p. 189).

domestic abuse,

> A girl being with her Gallant in A Tavern at Midnight, & when the heat was over; prov'd rue & wormwood to her Lover; & coud [sic] not get quit off her at last he unkindly kick'd her down stairs, down she Tumbled & broke her Leg, & was brought to y.e H next Morning, I examin'd y.e Leg & running A finger along y.e Tibia, I plainly perceiv'd y.e fract, & likewise y.e same in y.e Fib the first was broke about y.e small of y.e Leg, the last near y.e Ancle [sic]
> (KCL, St. Thomas' Surgical Student, 1725, n.p.).

interpersonal violence,

> the case of a man, who received a blow with a fist and suffered fracture of the lower jaw on the exact line of the Symphysis, and extending perpendicularly downwards between the two front incisor teeth
> (St. B, MR 16/1, p. 13).

and being caught in the crossfire of the Gordon Riots

> Hannah [Flenart] – 21 year of age of a good habit of body a married Woman was brought into the Hosp.l on Wednesday night the 7th [Just] with a compound Fracture of the Wrist Joint where in both Radius and Ulna were fractured, and the soft parts received considerable Injury from a musket ball shot by one of the soldiers who were on duty quelling the Disturbance
> (Wellcome Library, 1778-1781, MS 4337, p. 59).

The relationship between eighteenth-century Londoners and their surroundings was clearly complex and fraught with potential hazards. The working poor cannot be divorced from their historical context; as Thompson (1963) writes in his meditation on the concept of class, a study of the past "must always be embodied in real people and in a real context" (p. 9). Beyond acknowledging the role of individual clumsiness in producing falls, or of overcrowded traffic infrastructure bringing people and vehicles into contact, larger social and cultural issues are critical to consider. The political landscape of the "long" eighteenth century was one of great change as the lower classes voiced their social grievances through action, whether through the "moral economy" of check and balances affecting grain prices described by Thompson (1971) or through labour disputes, public demonstrations, or, less commonly, riots (Haywood & Seed, 2012).

As demonstrated in the final fracture example quoted above, sometimes large-scale political movements focused themselves in individual bodies. Anti-Catholic sentiments were high throughout the eighteenth century and the politics of the American

Revolutionary War were complex (Rogers, 2012). In June 1780, Lord George Gordon, leader of the Protestant Association, brought a petition of some 44,000 signatures to Parliament to repeal the Catholic Relief Act of 1778. Ostensibly the main aim of the Act was to allow more Catholics to fight for England since the Act "removed the requirements to condemn the Catholic Church when taking an oath of allegiance to the British crown" (Haywood & Seed, 2012, p. 2). Protestant citizens worried that the "unchaining [of Catholicism] will be dreadful to posterity" (An Appeal from the Protestant Association to the People of Great Britain, 1779, p. 45; Seed, 2012) and sought to repeal the act. Protestors besieged Parliament on 2 June 1780 and, after Gordon's motion to discuss the repeal was adjourned until the next week (following six hours of debate on the subject), the gathered crowd, some 40,000 to 60,000 strong, took to the streets in a series of attacks against Catholic churches and homes (Babington, 1990; Haywood & Seed, 2012).

In the days that followed, the attacks against property became less focused upon Catholics and the riots took a revolutionary turn, sacking the Newgate prison, New Prison, Clerkenwell, King's Bench, and the Fleet to release prisoners before the mob turned their attention to the Bank of England (Haywood & Seed, 2012). Several hundred rioters were shot dead and hundreds more wounded by bullets and bayonets after the military was given permission to "use force for dispersing the illegal and tumultuous assemblies of the people" (Hayter, 1978, p. 184) without first reading the Riot Act (Haywood & Seed, 2012). One such woman, Hannah [Flenart] suffered a compound fracture of the wrist from a musket ball; according to the St. Bartholomew's hospital surgeon's notes (Wellcome Library, 1778-1781, MS 4337, p. 59), the same ball also passed through her breasts. Hannah refused to have her hand amputated, so her arm was wrapped up in a poultice and she was given opiates for the pain. Loose fragments of bone were removed from the wound before she was discharged. She suffered her injuries on 7 June 1780, the day entitled "Black Wednesday," the apotheosis of the riots (Haywood & Seed, 2012; Randall, 2006). This isolated incident produces more questions than answers: why was Hannah present at the Black Wednesday riots? What were her political inclinations or was her presence fueled by a morbid curiousity? Did she provoke a soldier or was she an innocent bystander?

The detail available in the surgeons' notebooks provides a rich historical context in which to consider the antemortem and perimortem fractures observed in the skeletal sample.

6.3 MULTIPLE FRACTURES, RECIDIVISM, AND INTERPERSONAL VIOLENCE

6.3.1 Identifying fracture recidivists in the skeletal dataset

Fracture recidivism was investigated, following the criteria outlined by Judd (2002b). Table 6.1 shows that the majority of the young and middle adult skeletal groups did not have any fractures. There were no significant differences between the hospital and parochial groups amongst the categories for which an age could be estimated. Older adults in the parish/church sample with two or more fractures had the highest overall prevalence at 43.4%, followed by older adults in the hospitals sample.

Table 6.1 Number of males with zero to more than two antemortem and perimortem fractures

	Hospitals Sample				Parish/Church Sample			
		Number of Fractures				Number of Fractures		
Age Group	**N**	**Zero n (%)**	**One n (%)**	**Two + n (%)**	**N**	**Zero n (%)**	**One n (%)**	**Two + n (%)**
YA*	18	14 (77.8)	4 (22.2)	0 (0.0)	17	13 (76.5)	4 (23.5)	0 (0.0)
MA	70	36 (51.4)	12 (17.1)	22 (31.4)	126	75 (59.5)	16 (12.7)	35 (27.8)
OA	15	5 (33.3)	4 (28.6)	6 (40.0)	113	44 (38.9)	20 (17.7)	49 (43.4)
Adult	14	4 (28.6)	3 (21.4)	7 (50.0)	29	23 (79.3)	4 (13.8)	2 (6.9)
Total	117	59 (50.4)	23 (19.7)	35 (29.9)	285	155 (54.4)	44 (15.4)	86 (30.2)

* YA = young adult (18-25); MA = middle adult (26-45); OA = older adult (46+); Adult = individuals who could not be assigned to an age category. Values in parentheses are percentages = number of individuals with zero, one, or two+ fractures in age group / total number of individuals in age group.

Individuals may accumulate fractures over the life course; the skeleton becomes a physical record of traumatic incidents (Glencross, 2011; Gowland, 2006; Knudson & Stojanowski, 2009). The longer an individual lives the greater the chances to accumulate fractures. This is evident in both the hospital and parish/church skeletal samples. Risk factors relating to fracture change over an individual's life course. Buhr and Cooke (1959) and Court-Brown and Caesar (2006), among others (e.g., Alffram & Bauer, 1962; Fife & Barancik, 1985; Garraway, Stauffer, Kurland, & O'Fallon, 1979; Johansen et al., 1997; Jones, 1994; Singer et al., 1998), have aptly demonstrated that there is a relationship between fracture patterns and age. Factors such as decreasing bone mass with increasing age (Matkovic, Klisovic, & Ilich, 1995; Rizzoli, Bianchi, Garabédian, McKay, & Mereno, 2010) and bone strength related to muscle activity (Jones & Ma, 2005; Schoenau & Fricke, 2009) affect the risk of fracture. Occupation, nutritional status, and activity patterns, which are likely to be influenced by an individual's gender, affect the prevalence of fractures in a particular population (Roberts, 2006). As individuals age, falls become progressively more common with increasingly serious consequences due to underlying morbidity factors such as undernutrition (Bennett & Hogan, 2008; Gruber et al., 2006).

Table 6.2 Number of females with zero to more than two antemortem and perimortem fractures

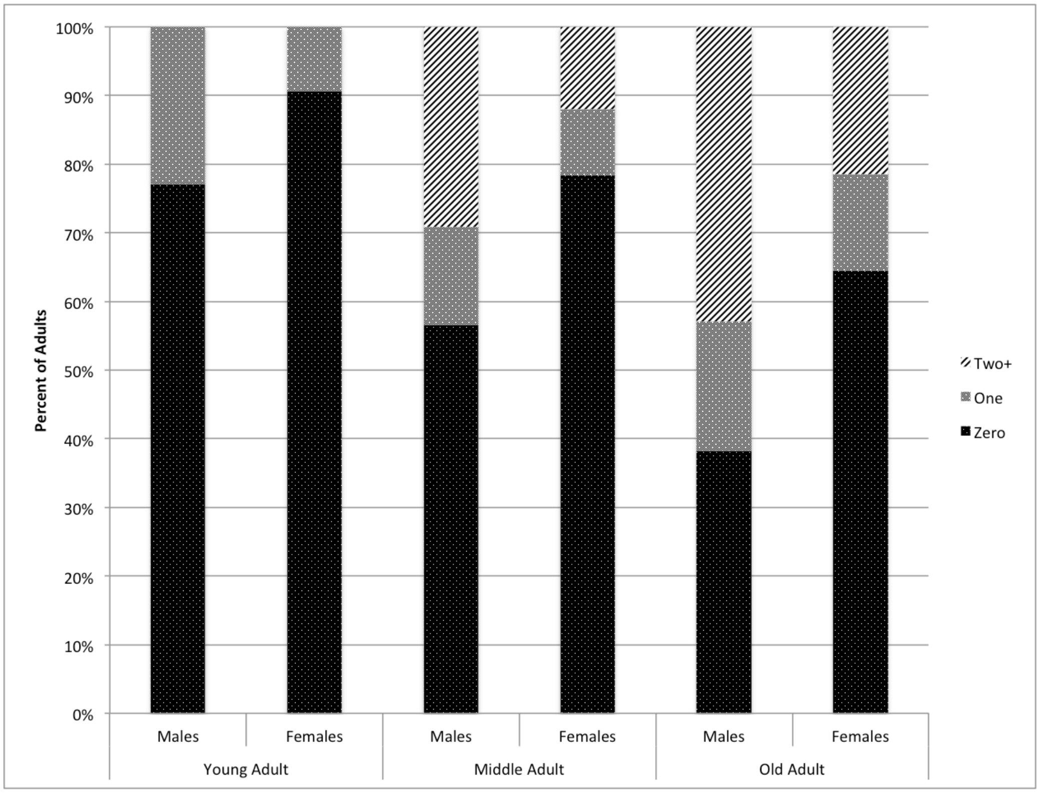
	Hospitals Sample				**Parish/Church Sample**			
		Number of Fractures				**Number of Fractures**		
Age Group	**N**	**Zero**	**One**	**Two +**	**N**	**Zero**	**One**	**Two +**
YA*	14	12 (85.7)	2 (14.3)	0 (0.0)	18	17 (94.4)	1 (5.6)	0 (0.0)
MA	31	25 (80.6)	2 (6.5)	4 (12.9)	127	99 (78.0)	13 (10.2)	15 (11.8)
OA	7	2 (28.6)	2 (28.6)	3 (42.9)	100	67 (67.0)	13 (13.0)	20 (20.0)
Adult	5	5 (100.0)	0 (0.0)	0 (0.0)	17	15 (88.2)	1 (5.9)	1 (5.9)
Total	57	44 (77.2)	6 (10.5)	7 (12.3)	262	198 (75.6)	28 (10.7)	36 (13.7)

* YA = young adult (18-25); MA = middle adult (26-45); OA = older adult (46+); Adult = individuals who could not be assigned to an age category. Values in parentheses are percentages = number of individuals with zero, one, or two+ fractures in age group / total number of individuals in age group.

Similar to the findings of Table 6.1, Table 6.2 shows that the majority of individuals in the young and middle adult categories did not have any fractures. The groups with the highest overall prevalence were the older adults from the hospital sample with multiple fractures (42.9%) or one fracture (28.6%). There were no significant differences between the groups amongst the categories for which an age could be estimated.

The parish/church and hospital data were pooled for males and females and these data are visualized in Figure 6.1.

Figure 6.1 Distribution of adults by number of injuries and age category



The male sample had an overall higher prevalence of fractures than the female sample. The pooled male and female datasets were compared using the Chi-square test. Females in the MA (χ^2 = 18.713, $p < 0.0001$, 1 df) and OA (χ^2 = 16.009, $p < 0.0001$, 1 df) were significantly more likely to have zero fractures and males in the MA (χ^2 = 15.095, $p < 0.0001$, 1 df) and OA (χ^2 = 12.119, $p < 0.0001$, 1 df) categories were significantly more likely to have multiple (2+ fractures). This finding matches the clinical definition of a recidivist as a male individual (Goins et al., 1992; Hedges et al., 1995; Kaufmann et al., 1998; Reiner et al., 1990).

Tables 6.1 and 6.2 show that there were a total of 164 individuals (121 male and 43 female) with two or more fractures, but in only 14 cases was there a mixture of perimortem, healing, and healed elements. During skeletal data collection, I observed antemortem healed fractures, antemortem healing fractures, and perimortem fractures. As outlined in Section 3.2.5.6, individuals in the skeletal sample were determined to show evidence of multiple incidents of fracture in two circumstances. In the first, the individual had one or more fractures currently undergoing callus building or remodeling in addition to one or more fractures that were remodeled (Figure 6.2). In the second, the individual had one or more perimortem fractures in addition to one or more healed or healing fractures.

Figure 6.2 Examples of rib fractures at different stages of healing: Above RLP05 242 showing active remodeling and below, FAO90 2302 showing a healed callus

Table 6.3 displays the 14 individuals demonstrating fracture recidivism, 12 males and two females. It is not usually possible to distinguish between individuals who suffered multiple injuries in one incident versus those who experienced the fractures in separate incidents, but the presence of perimortem trauma and bone showing active remodeling allows for a relative sequence of fracture events to be reconstructed. The antemortem fractures suffered by these individuals may have occurred in multiple incidents, but that information is impossible to glean from the antemortem fractures. Brickley (2006) notes that the age-at-death estimation for individuals with healing fractures is of particular importance, because the fracture incident "probably occurred within two months of death" (p. 67). Interestingly, the individuals with multiple fractures in various stages of healing fall primarily in the MA2 (6/14 = 42.9%) and OA age categories (4/14 = 28.6%). These results do not fall within the clinical definition of an injury recidivist outlined by Reiner et al. (1990), but may instead suggest that these individuals suffered further complications from their fractures such as soft tissue injuries, vascular damage, opportunistic infections, or respiratory compromise in the individuals with one or more healing rib fractures.

Nine individuals (9/14 = 64.3%) had one or more rib fractures healing at the time of death and seven of the individuals were assigned to the MA2 or OA categories; it is possible that these individuals were over the age of 45, the age at which Holcomb et al. (2003) posit there is an increased risk of morbidity and mortality from rib fractures. Morbidity and mortality increase following rib fractures, particularly among older individuals (Bergeron et al., 2003; Bulger et al., 2000; Holcomb et al., 2003; Stawicki et al., 2004).

It is possible that the demographic profile of individuals most likely to suffer repeated injuries has changed since the "long" eighteenth century, due to factors such as overall increased life expectancy, changes in medical care access, and occupational safety initiatives. Also, the lack of specific occupational information for the individuals in the skeletal sample limits the possibility of investigating the risks of specific occupations.

Table 6.3 Summary of injury recidivists in the skeletal sample

Sex	Individual	Age Group	Healed	Healing	Perimortem
Male	PAY05 184	OA*	4 ribs L* fibula	4 ribs	-
	FAO90 1141	MA2	4 ribs	2 ribs	-
	FAO90 1546	MA2	R tibia R fibula 2 ribs R metacarpal 3 R metacarpal 5 Proximal manual phalanx	3 ribs	-
	FAO90 1862	OA	13 ribs	2 ribs	-
	FAO90 2243	MA2	1 rib	2 ribs	-
	FAO90 2302	MA1	3 ribs	8 ribs	
	RLP05 124	OA	2 ribs R metatarsal 4	R femur	-
	RLP05 138	MA2	L & R nasals R os coxa 3 ribs	-	R fibula
	RLP05 242	MA2	4 thoracic vertebrae 2 ribs	2 ribs	
	RLP05 398	AD	L os coxa	-	R radius R tibia
	RLP05 34803	AD	L & R nasals	1 rib	-
	RLP05 11502	MA2	R metacarpal 5	1 rib	-
Female	PAY05 243	AD	L radius	L scapula	-
	RLP05 247	OA	R radius	-	R tibia

* MA1 = middle adult 1 (26-35); MA2 = middle adult 2 (36-45); OA = older adult (46+); AD = adult; L = left; R = right.

Table 6.4 Number of individuals with multiple fractures in varied stages of healing

		Hospitals Sample			Parish/Church Sample		
Sex	**Age Group**	**N Age Group**	**n affected individuals with one or more fractures**	**n affected total individuals**	**N Age Group**	**n affected individuals with one or more fractures**	**n affected total individuals**
Male	MA*	70	3/34 (8.8%)	3/70 (4.3%)	126	4/51 (7.8%)	4/126 (3.2%)
	OA	15	1/10 (10.0%)	1/15 (6.7%)	113	2/69 (2.9%)	2/113 (1.8%)
	Adult	14	2/10 (20.0%)	2/14 (14.3%)	29	-	-
Female	OA	7	1/5 (20.0%)	1/7 (14.3%)	100	-	-
	Adult	5	-	-	17	1/2 (50.0%)	1/17 (5.9%)

* MA = middle adult (26-45); OA = older adult (46+); Adult = individuals for whom age could not be estimated beyond being an adult.

Table 6.5 Fourteen individuals with multiple fractures summarized by sex

	Hospitals Sample		Parish/Church Sample	
Sex	**n affected total number of individuals with one or more fractures**	**n affected total number of individuals**	**n affected N fractured individuals**	**n affected total number of individuals**
Male	6/58 (10.3%)	6/117 (5.1%)	6/130 (4.6%)	6/285 (2.1%)
Female	1/13 (7.7%)	1/57 (1.8%)	1/64 (1.6%)	1/262 (0.4%)

Tables 6.4 and 6.5 display the 14 individuals observed with multiple fractures in various stages of healing. Table 6.4 shows that the highest prevalence of multiple fractures in various stages of healing in sexed and aged individuals was present in female and male older adults from the hospitals sample. The prevalence of multiple fractures in various stages of healing was higher in the hospitals sample for all categories in which there were data available for both skeletal samples, though these differences were not statistically significant. The overall male skeletal sample (Table 6.5) had a statistically

significant higher prevalence of individuals with fractures in varied stages of healing than the overall female sample (Fisher's exact test statistic: 0.027821, $p < 0.05$).

6.3.2 Identifying individuals with multiple fracture incidents in the hospital admissions dataset

Identifying individuals who have suffered multiple fractures in the hospital admission records is a challenge. In total, 41 individuals who could potentially have suffered multiple fractures were identified. The first group (n = 20) comprises instances where the same name appears more than once, but is associated with different injuries (Appendix E). For example, an individual named James Brown was admitted to Guy's Hospital on 20 May 1833 (left 7 August 1833) with a fractured arm. James Brown was also admitted to Guy's Hospital on 28 July 1834 (left 3 September 1834) with a fractured leg. It is possible that these admissions represent the same individual, though the impossibility of record linking makes any claim equivocal.

The second group (n = 21) includes cases where individuals appear to enter hospital, be discharged, and then re-enter the same hospital with the same fractured element within a few days to a year (with one exception) of their original discharge (Table 6.6). This attempt to identify individuals with repeat admission to the voluntary hospitals is tentative. There are no individualized medical records to consult and therefore the results in Table 6.6 must remain speculative. The speculation is aided by individuals with relatively unique names, such as Titus Buckland, returning to hospital within a short period of time with the same fracture.

Contemporary studies suggest that, without complications, bones should show signs of significant healing between four and six weeks post fracture, with lower extremities requiring longer immobilization periods than the upper extremities (Eiff & Hatch, 2011). The average number of days spent in the hospitals investigated in this research (Appendix C, Table C.13) for many fractured elements is more than four to six weeks (i.e., 28 to 42 days) suggesting that, the average patient admitted to a voluntary hospital in London stayed in hospital long enough for substantial healing to take place. These results contrast Risse's (1986) observation that at the Royal Infirmary of Edinburgh, the term "cured" was used liberally, and often applied to patients "who appeared to be on the mend" (p. 230). Risse (1986) notes that lengthy hospital visits were undesirable for the governors of the hospital who recognized that statistics demonstrating patient turnover and many individuals "cured" were good for publicity. The adequate average length of hospital stay (Appendix C, Table C.13) in the voluntary hospitals under scrutiny contributes to the growing literature (See Section 2.8) seeking to reevaluate the poor reputation of eighteenth-century hospitals.

A variety of factors may be affecting the 21 individuals who were readmitted to hospital with the same fractured element. Many factors affect average fracture healing time. Before the advent of radiographs, physicians and surgeons during the "long" eighteenth century relied entirely upon clinical features of fracture healing such as the individual's ability to bear weight (Joslin et al., 2008), lack of tenderness at the fracture site (Eiff & Hatch, 2011), and lack of pain during manual stress testing (McGowan, 2008). Healing times depend upon a variety of factors beyond patient behaviour and acceptance of immobilization, including age and sex of the individual (Parker, Raghavan, & Gurusamy, 2007), vitamin D intake (Ettehad et al., 2014), whether an individual smokes (e.g., Castillo, Bosse, MacKenzie, Patterson, 2005; Harvey, Agel, Selznick, Chapman, & Henley, 2002), and preexisting conditions such as osteoporosis (e.g., Augat, Simon, Liedert, & Claes, 2005; Marmor et al., 2015; Nikolaou, Efstathopoulos, Kontakis, Kanakaris, & Giannoudis, 2009) and diabetes (e.g., Looker, Eberhardt, & Saydah, 2016; Oei, Rivadeneira, Zillikens, & Oei, 2015). Behavioural factors are a likely contributor to the re-admittance; it is impossible to account for individual clumsiness or attention to fracture aftercare. In addition, individuals may have been repeatedly exposed to occupational hazards.

Not all patients were lucky enough to heal completely during their convalescence. A student at St. Thomas' Hospital recorded a case of an individual fracturing the same leg three times:

> A leg thrice fractur'd
>
> A young fellow had his Leg run over by A Cart & both bones broke, it was reduc'd & dress'd up at St Barthol: & he kept his bed A month, then they suffer'd him to rise & walk with Crutches, supposeing [sic] y.e Callus Confirm'd, his Crutch broke & down he tumbled & broke y.e Bones again, they were bound up A second time, & he confin'd to bed 5 weeks, then they suffer'd him to rise & walk A little with Crutches as before, till he was pritty [sic] well, & then he was presented out adviseing [sic] him to wear y.e Dressings sometime till y.e Callus was stronger…. Not long after this he accidentally tumbled down A pair of stairs & broke y.e Leg again, And was brought to St Thom: und.r Mr Chesel.n
>
> Jan 26 Mr Craddock took off y.e old dressings, reduced y.e bones, & bound up y.e Limb with y.e Same, & he remain'd easy, but was not open'd again while I stay'd
>
> (KCL, GB 0100 TH/PP44, 1725-26, n.p.).

The young man fractures his tibia and fibula, refractures the bones whilst in hospital, and then after discharge, but "not long after," suffers another accident and is readmitted for the same injury. There is potential that the 21 individuals included in Table 6.6 may have dealt with similar frustrations to their recovery.

Table 6.6 Possible cases of repeated admission for fractures to the same element

Name	**Element**	**Admission Date**	**Discharge Date**
Middlesex Hospital			
Elizabeth Goddard	Patella	9 February 1782	30 April 1782
	Patella	7 October 1782	24 December 1782
Mary Bradley	Patella	24 March 1783	6 May 1783
	Patella	30 May 1783	10 June 1783
Ann McDonald	Arm & Leg	4 May 1785	13 September 1785
	Thigh	13 September 1785	6 February 1786
Thomas Grimes	Thigh	25 February 1787	17 April 1787
	Thigh	21 April 1787	17 July 1787
	Thigh	25 July 1787	9 October 1787
Joseph Barthold	Leg	4 June 1787	24 July 1787
	Leg	27 July 1787	7 August 1787
St. Thomas'			
Susannah Buckle	Cranium	25 June 1789	23 July 1789
	Cranium	6 August 1789	27 August 1789
Guy's Hospital			
Bartholomew Hutchison	Thigh	8 January 1814	2 March 1814
	Thigh	20 January 1815	12 April 1815
John Saunders	Leg	22 February 1816	24 April 1816
	Thigh	13 June 1816	14 August 1816
Sarah Stevens	Arm	19 August 1816	28 August 1816
	Arm	30 August 1816	11 September 1816
Titus Buckland	Arm	14 May 1817	25 June 1817
	Arm	4 July 1817	13 August 1817
John Webb	Ribs	8 December 1817	24 December 1817
	Ribs	12 January 1818	18 February 1818
Benjamin White	Leg	2 December 1818	13 January 1819
	Leg	17 January 1819	24 March 1819
Mary A Harvey	Arm	6 April 1824	21 April 1824
	Arm	7 November 1824	15 December 1824
William Clark	Thigh	24 May 1826	1 November 1826

	Thigh	2 November 1826	13 December 1826
Samuel Johnson	Arm	16 August 1826	10 January 1827
	Arm	31 January 1827	30 May 1827
	Arm	21 November 1827	23 April 1828
Edward Eager	Leg	21 July 1827	29 August 1827
	Compound femur	17 July 1828	15 July 1829
Thomas Smith	Leg	26 April 1835	10 June 1836
	Leg	29 November 1836	11 January 1837
Anthony Randall	Leg	28 November 1829	13 January 1830
	Leg	28 February 1830	5 May 1830
Ann Gooch	Arm	17 March 1830	28 April 1830
	Arm	27 June 1830	28 July 1830
Michael Hart*	Arm	26 September 1834	17 December 1834
	Arm	20 April 1836	25 May 1836
William Reynolds	Knee	9 July 1836	12 October 1836
	Knee	26 October 1836	22 March 1837

* One individual, Michael Hart, was not re-admitted within one year.

6.3.3 Interpersonal violence

“JAMES WESTON was indicted for that he on the 2d day of June last, on one William Cuit deceased, did make an assault, and with both his hands did strike the said William Cuit in and upon his head, face, stomach, back, belly and sides, and with his feet did cast and throw the said William Cuit upon the ground, giving him thereby one mortal bruise and fracture in and upon his right leg, of which he the said William Cuit, from the said 2d day of June till the 18th day of the said month languishing did live, and on the day and year aforesaid, did die.

…

ROBERT PENNINGTON sworn.
I am one of the surgeons of St. Bartholomew’s hospital; I remember the deceased being brought to the hospital on the 2d of July, about twenty minutes before one on the Sunday morning; he was brought on a board, and I was desired to look at his leg; I examined him and found a dislocation of the ancle [sic], with a fracture of the small bone; I examined it very minutely, and I told his friends it would be mortal.”

(Old Bailey Proceedings Online, September 1787, trial of James Weston, t17870912-96).

In the male skeletal sample there were 35 individuals with maxillofacial fractures (Table 6.7). There were 34 individuals with nasal fractures, one individual with a maxillary fracture, one individual with a mandibular fracture, and two individuals with fractures to the zygomatic arch. Of the 35 individuals with metacarpal fractures, 10 had multiple metacarpal fractures. There were twelve individuals with injuries to the cranial vault; nine individuals showed evidence of antemortem blunt force trauma, and three individuals had suffered antemortem sharp force trauma. Figure 6.3 displays an example of healed cranial blunt force trauma and healed cranial sharp force trauma.

Figure 6.3 – Blunt force trauma (FAO90 1827) and sharp force trauma (FAO90 1809) examples

Table 6.7 Crude prevalence of VRIs in the male skeletal sample

Element	Number of individuals affected / Total number of individuals
Nasal	34/402 (8.5%)
Mandible	1/402 (0.2%)
Maxilla	1/402 (0.2%)
Zygomatic	2/402 (0.5%)
Metacarpals	35/402 (8.7%)
Cranial	12/402 (3.0%)
Ribs	100/402 (24.9%)

Following the example of Brickley and Smith (2006), the relationship between VRIs and individuals with multiple fractures was investigated. Table 6.8 displays the incidence of multiple fractures by type in the male skeletal sample. Maxillofacial in this case includes nasal, maxilla, mandible, and zygomatic fractures.

Table 6.8 Prevalence of multiple fractures by type in the male skeletal sample

Injury	Individuals with multiple injuries / Individuals with element fracture
All Fractures	121/197 (61.4%)
Ribs	85/100 (85.0%)
Metacarpals	29/35 (82.9%)
Maxillofacial	29/35 (82.9%)
Cranial Vault	8/12 (66.7%)
All VRIs	57/73 (78.1%)
Excluding VRIs	70/124 (56.5%)

Values in parentheses are percentages.

The percentage of individuals with VRIs that have multiple fractures is higher than that for the "all fractures" group; this difference was statistically significant (χ^2 = 6.5817, $p < 0.05$). According to Brickley and Smith (2006), this result supports "the notion that the VRIs examined have a different etiology from other types of fracture" (p.

170). Individuals with rib fractures were also statistically significantly more likely to have multiple fractures than the "all fractures" group ($\chi^2 = 17.3521$, $p < 0.05$). Of the 100 male individuals with rib fractures, 64 (64.0%) individuals had more than one rib fracture; the number of rib fractures found in a single individual ranged from one to 15. Rib fractures may have been sustained during an interpersonal incident, but this etiology is not unequivocal. These results suggest that there is an association between individuals suffering multiple injuries and VRIs, a relationship similar to that of modern populations and the skeletal sample uncovered at St. Martin's, Birmingham (Brickley & Smith, 2006).

Palaeopathological and historical studies have discussed the presence of trauma caused by interpersonal violence (e.g., Alvrus, 1999; Blondiaux et al., 2012; Bloom & Smith, 1991; Dawson, Levy, & Smith, 2003; Domett & Tayles, 2006; Grauer & Roberts, 1996; Gupta, Chandra, & Dogra, 1982; Hutchinson, 1996; Judd, 2004, 2006; Keeley, 1996; Lessa & de Souza, 2004; Martin & Frayer, 1997; Mercer, 1999; Mitchell, 2006; Paine, Mancinelli, Ruggieri, & Coppa, 2007; Patrick, 2006; Smith, 1996; Stirland, 1996; Sutter & Cortez, 2005; Torres-Rouff & Junqueira, 2006; Walker, 1997; Vencl, 1999) and it is clear that interpersonal violence is present in all cultures and temporal periods at various levels (Brickley & Smith, 2006). Hershkovitz et al. (1996) examined individuals in the Hamann-Todd collection, curated at the Cleveland Museum of Natural History, who were known to have engaged in boxing and hand-to-hand combat during their lives. The authors outline a suite of skeletal characteristics that may suggest an individual was involved in fighting, including: fractures of the zygomatic arch and nasal bones, a large number of fractured ribs, and multiple fractures of fingers and toes (Hershkovitz et al., 1996, p. 177). A clinical survey of professional boxers found that facial lacerations comprised 51% of the total injuries, followed by hand injuries at 17%; nasal injuries comprised only 5% (Bledsoe, Li, & Levy, 2005). Individuals sustaining violence-related injuries are often injury recidivists (Brink et al., 1998; Buss, Rashid, & Walker, 1995; Greer & Williams, 1999; Mercan et al., 2004), a finding that is supported by the present study.

Sex-based bias towards males has been found cross-culturally in modern studies of violence (e.g., Ogundare, Bonnick, and Bayley, 2003; Hutchison, Magennis, Shepherd, & Brown, 1998; Karagama, Newton, & Clayton, 2004). Contemporary studies of violence reveal that young men are the most common "perpetrators and victims of modern assaults" (Walker, 2001, p. 580). Men are more likely, at any age, to suffer traumatic injuries and be involved in violent encounters (Baker, 1992). Rand (1997) reports that males represented 60% of all individuals treated in US hospital emergency rooms as a result of injuries sustained due to violence. Studies concerning intentional violence, such as Ord and Benian's (1995) study of American individuals with baseball bat injuries, discovered that 93% of the victims were male. In the skeletal sample, male individuals had a significantly higher prevalence of nasal, metacarpal 1, and metacarpal 5 fractures than females.

The face is the most common target in violent interpersonal incidents. Walker (2001) posits that this patterning has to do with the psychological link between the head and the face; to an assailant the individual's face may be inextricably linked to the victim's identity. Several international studies (e.g., Brink et al., 1998; Hussain, Wijetunge, Grubnic, & Jackson, 1994) cite that the majority of craniofacial fractures are caused by violence. Others have found road traffic accidents to be the primary cause, followed by falls and interpersonal violence (Gassner, Tuli, Hachl, Rudisch, & Ulmer, 2003; Motamedi et al., 2014). Hutchison et al. (1998), studying Britain, report that 45% of facial fractures are caused by assaults. Karagama et al. (2004) notes that the nasal bone is most commonly fractured, followed by the mandible (Ogundare et al., 2003). The authors note that 79% of mandibular fractures, reported in a ten-year retrospective analysis of an urban trauma centre in Washington, D.C., were caused by violence. Trauma to the cranial vault has been examined and Lambert (1997) notes that it is often possible to differentiate between cranial injuries sustained due to accidents such as falls from weapon-related trauma.

Fractures to the bones of the hand are often connected to interpersonal violence. It is possible for metacarpal fractures to be the result of falls, but the most common clinical proximate cause of metacarpal fractures is "striking a solid object with a clenched fist" (Brickley & Smith, 2006, p. 164). Brink et al. (1998) report that, after the facial skeleton, the hand is the most common location for violence-related fractures. Metacarpal fractures resulting from punching are often termed "punch" or "Boxer's" fractures, usually in reference to the fifth metacarpal (Salter, 1999; Wyatt et al., 2004). Greer and Williams's (1999) study of boxer's fractures in West Virginia discovered that 92% were found in male individuals; males are more likely to be affected by hand fractures due to intentional trauma in general (Van Onselen, Karim, Joris Hage, & Ritt, 2003).

The distribution of metacarpal fractures in the skeletal sample is suggestive of a violent etiology. If the fractures were all associated with occupational accidents or falls, a more even distribution of fractures throughout the metacarpals would likely be observed. First metacarpal fractures (n= 26) make up 54.2% of all metacarpal fractures in the male skeletal sample, with fifth metacarpal fractures (n = 10) comprising 20.8% of the sample. Brickley and Smith (2006) suggest that the presence of first metacarpal fractures may be related to the style of boxing prior to the adoption of the Queensberry rules in 1875. Prior to Queensberry, English boxing matches were fought bareknuckle, or without gloves, and individuals punched vertically, with the palms and first digit placed medially (Ruzicki, 2003). This style of punching was designed to reduce damage to the hands, but exposes the thumb to the brunt of the punch's force if the punch glances off the target. As noted in Chapter 5 (p. 22), the preponderance of metacarpal five fractures is likely the result of inaccurate or untrained punches (Walsh, 2004).

The patterning of metacarpal and maxillofacial injuries present in the male skeletal sample suggest that interpersonal violence may be responsible for many of the fractures. Walker (1997) suggests that punching opponents and targeting the face is possibly the result of "cultural conditioning" (p. 168) of young males of fist fighting as a "manly" way of defending oneself. Clark (1997) and Shoemaker (2007) expound that controlled violence was a common and accepted way of asserting masculinity; fighting was, therefore, a natural aspect of the lives of the working poor. Men often engaged in boxing matches and the Trades' Newspaper (17 July 1825) explained that "an instant use of one's fist, in resentment of an insult or blow, is manly" (qtd. in Clark, 1997, p. 31).

Shoemaker (2001) outlines a variety of insults that led to violent encounters recorded at the Old Bailey, such as "allegations of dishonesty ('scoundrel'), lack of control of one's wife ('cuckold'), or of not acting like a gentleman to immorality ('pimp') and general low life ('rogue', 'dirty fellow')" (p. 194).

The Old Bailey Sessions Papers record myriad cases in which men worked out interpersonal issues with their fists. One John Humphries Parry insulted a bricklayer in 1825; the bricklayer was recorded as declaring: "Stand up, like a man!" before dealing Parry a "tremendous blow in the mouth, and then struck him a tremendous blow on his side" (Old Bailey, 1825). In the Old Bailey records concerning the murder of Isaac Bennet, the violent incident is recorded to have been initiated due to "high Words…betwixt them" after which John Thompson "went up to the Deceas'd, and gave him a Shove, who return'd it by a Blow on the Face…so that the Blood gush'd out of his Nose" (Old Bailey, 1714, t17140908-20). These examples demonstrate that interpersonal violence was certainly present in London during the "long" eighteenth century as a means of settling scores and demonstrating dominance.

6.3.4 Historical evidence for gendered violence

Walker (1997) suggests that the rise of popular sport, such as boxing, may have influenced fighting styles. Boxing arose as both a way of settling disagreements and as a popular recreational sport (Shoemaker, 2007). These concepts are supported by contemporary commentators such as César de Saussure, who wrote in 1727 that when there is a disagreement between two men of the working class

> which they cannot end up amicably, they retire into some quiet place and strip from their waist upwards…The two champions shake hands before commencing, and then attack each other courageously with their fists, and sometimes also with their heads, which they use like rams
>
> (de Saussure, 1902, p. 180).

Boxing matches were a frequent occurrence, and spontaneous matches often materialized during public holidays and celebrations such as the Lord Mayor's banquet (Shoemaker, 2007). Boxing was immensely popular among the English; one visitor to London commented that:

> anything that looks like fighting is delicious to an Englishman…During the fight, the ring of bystanders encourage the combatants with great delight of heart, and never part them while they fight according to the rules: and these bystanders are not only other boys, porters, and the rabble, but all sorts of men of fashion; some thrusting by the mob…others getting upon stalls
>
> (Mission 1697, cited in Shoemaker, 2007, pp. 197-198).

By the 1780s, the sport had received patronage from the Prince of Wales and celebrity athletes such as Daniel Mendoza and Richard Humphreys (Figure 6.4) were celebrated in the papers (Shoemaker, 2007). Not all commentators were impressed with the increasing popularity of boxing; an author in the *Daily University Register* (later, the *Times*), wrote snidely that

> if we may judge from the present progression…we may venture to presage that black eyes and bloody noses will shortly succeed to [replace] patches and dimples in all beautiful countenances
>
> (12 December 1797, cited in Shoemaker, 2007, p. 202).

Despite its more widespread acceptance, boxing was, to many, still considered a sport of the lower classes; upper class men who tried their hand at boxing were thought to be emulating "the hardiness of the labourer" (1752; cited in Shoemaker, 2007, p. 209).

Figure 6.4 Richard Humphreys and Daniel Mendoza – January 9, 1788

(The famous Battle between Richard Humphreys and Daniel Mendoza. Unknown Artist. Published by Samuel William Fores, 11 January 1788. © National Portrait Gallery, London)

Not all violent encounters were surrounded by a cheering crowd. The historical record provides tantalizing detail of violent assaults, such as that which occurred to William Middleton, age 40. Middleton was:

> working in a hay field, & was attacked by 4 or 5 Irishmen, who beat him with pitchforks & an adze – the principle wound is over the sagittal suture & communicates with the fracture where a portion of the skull over the longitudinal sinus is depressed about ½ an inch deep & about the size of a shilling, the other wound do [sic] no expose the skull. He was stunned by the blow, but soon recovered, he lost much blood, & when he came here (about 4

> hours after the accident) he was faint & weak but perfectly sensible, & labouring under no symptom of compression – The wound were dressed lightly, & cold lotion was applied to the Head, the lower Jaw is fractured about an inch from the Symphysis with no displacement
> (RCS, MS0470, 51, 1827-1849).

Jones (1991) recorded that fractures were commonly treated at St. Thomas' Hospital, many "as a result of brawls in the narrow streets" (p. 23) and J.H. Meister noted in 1799 that while "murders are very rarely the consequence" that "frequent quarrels arise amongst the populace" (pp. 169-170). McInnes (1954) notes a case in which John Busse, a tailor, fractured a woman's skull and was ordered to pay the 20 pence for her treatment at the hospital. Street beggars were rumoured to sometimes resort to violence or threats to encourage or coerce charitable giving. Thomas Paven was charged in 1719 with "begging, frequently pretending to fall in to fits, at other times attempting with a broom stick to break heads when not relieved" (Guildhall Library, MS 33011/21, p. 234).

Violence was not limited to males during this period, but men were responsible for the majority of murders (87%) tried at the Old Bailey (Shoemaker, 2007). Women were less likely to be tried for robberies and committed fewer non-fatal violent attacks than men (less than 1/3 of cases tried at the Old Bailey) (Shoemaker, 2007). There are, however, some shocking examples of violence involving women, such as the May 1751 brawl between two women in Covent Garden Market. The two women fought and "one struck the other with a bed screw which she had in her hand, by which means she fractured her skull, so that she died on the spot" (London Evening Post, 1751). It is posited that because women's violence was not ritualized or based upon an "accepted form of staged combat" (Shoemaker, 2001, p. 202) such as boxing, female violence was more spontaneous and certainly “bellicosity was less common than it was amongst men” (Durston, 2013, p. 114). Further, “women were particularly unlikely to participate in the semi-regulated, organized fights that men used to settle quarrels” (Durston, 2013, p. 133).

Violence against women in the form of domestic violence is a subject worthy of investigation. Foyster (2005) criticizes the traditional historical approach of using court-recorded murders as a proxy for violence since this overlooks non-lethal violence such as domestic abuse. She states that “domestic violence does not yet yield evidence that can be readily translated into reliable numbers or statistics” (Foyster, 2005, p. ix). Historical investigations into domestic violence during the eighteenth and nineteenth centuries (e.g., Bailey, 2003; Foyster, 2002; Hunt, 1992; Tomes, 1978) detail the complex webs of social relationships involved in domestic incidents, including the perpetrators, victims, their friends, the courts, and the church. Individuals tended not to intervene in the occasional scuffle between couples unless the “violence was one-sided, when men were out of control, when it was against children, or when it was systematic” (Bailey, 2003, p. 123). As Doggett (1993) explains, the law protected a husband’s reasonable chastisement (read: confinement to the house) of his wife, but this was not a legal license to beat her. Bailey (2003) explains that eighteenth-century popular opinion accepted that violence against one’s wife was allowable under extreme circumstances such as bigamy, adultery, or prostitution. Bruises and burns were the most common results of violence at the hands of men, but Bailey (2003, p. 114) describes a case in 1763 wherein James Aris beat his wife severely enough to dislocate her elbow and fracture her arm.

The use of swords in violent encounters was common. Swords were not limited to the upper classes; Shoemaker's (2007) calculations indicate that 55% of male defendants who were tried for causing a murder with a sword in London were not military men or gentlemen. A disagreement involving a sword occurred in June 1771 when a hackney coach passenger did not have sufficient change to pay for his fare. The coachman seized the passenger and demanded, "he would be paid before he quitted his hold"; the passenger "drew his sword, and ran the coachman through the arm" (General Evening Post, 1771). The force of a sword contacting a limb could result in a case of sharp force trauma or possibly cause a fracture.

Historians often employ historical homicide rates as a measure of the incidence of violence in the past. This technique has allowed historians to posit that the overall levels of violence declined in London over the "long" eighteenth century (Gurr, 1981; Sharpe, 1996; Shoemaker, 2001). Emsley (1996) notes that there is no direct correlation between murder frequency and the overall amount of violence in a society, but unpremeditated deaths from assaults may give a measure of the prevalence of public and street violence (Sharpe, 1983). The evidence of interpersonal violence recorded as antemortem fractures found in skeletal remains is, therefore, a crucial data source in the reconstruction of historical violence. Though the Old Bailey Papers contain many examples of violence between men, it was considered a sign of weakness or 'unmanliness' to complain to the courts (Shoemaker, 2007), suggesting that relying only upon Old Bailey evidence would result in an underestimation of violence in London.

6.4 OCCUPATIONS DATA FROM THE ROYAL LONDON HOSPITAL

The occupations data are tabulated in Table 6.9. The state census only began to collect national data on the distribution of occupations in 1841 (Scheuer & Bowman, 1995), thus the prevalence of occupations in the hospital records cannot be compared to a national average. Lindert (1980) and Lindert and Williamson (1982, 1983) have examined data sources such as parish records and trade directories for information concerning occupations, but they acknowledge that these sources are both incomplete and unlikely to record information concerning the poor.

Labourers made up the largest proportion of male individuals (126/276 = 45.7%). This category included individuals who were listed simply as labourers and those in unskilled professions such as coalheaving. The female occupation category is less revealing since 39.6% (n = 38) of the female individuals were listed as the wife of a male profession. Women, however, were listed as servants (16/96 = 16.7%), labourers such as charwomen (16/96 = 16.7%), tradeswomen such as silk weavers (4/96 = 4.2%), and nurses (5/96 = 5.2%).

Table 6.9 Occupation categories of individuals admitted to the Royal London Hospital for fractures

Sex	Occupation Category	Number of individuals
Males	Armed Forces	43 (15.6%)
	Tradesmen	56 (20.3%)
	Labourer	126 (45.7%)
	Agricultural Worker	11 (4.0%)
	Industrial Worker	1 (0.4%)
	Servant	26 (9.4%)
	Miscellaneous	8 (2.9%)
	Unknown	5 (1.8%)
	Total	**276**
Females	Armed Forces Wife	5 (5.2%)
	Tradesman's Wife	15 (15.6%)
	Labourer's Wife	14 (14.6%)
	Servant's Wife	4 (4.2%)
	Servant	16 (16.7%)
	Labourer	16 (16.7%)
	Tradeswoman	4 (4.2%)
	Nurse	5 (5.2%)
	Widow	14 (14.6%)
	Beggar	1 (1.0%)
	Unknown	2 (2.1%)
	Total	**96**

Tables 6.10 and 6.11 display the occupation categories of male and female individuals admitted to the Royal London due to fracture, organized in the element groups used in Chapter 4 (i.e., cranial, torso, arm, hand, leg, foot). Legs were the most frequently fractured category for each occupational group in the male sample, but there were no significant differences between the occupations for leg fracture frequency. Leg fractures, including fractures to the femur, tibia, fibula, knee, and patella, are the most likely to affect an individual's ability to walk. Ambulation would have been crucial for an individual to get to their place of work and the majority of the occupations found in the Royal London admission records (with the exception, perhaps of the single recorded

fiddler) would have required an individual to have freedom of movement. The female results in Table 6.11 provide less detail than those of the male because many women are categorized as being the wife of their husband's occupation. The female individuals working as servants and labourers (e.g., charwomen, street hawkers or dealers) were most likely admitted to hospital due to a leg fracture.

Table 6.10 Occupation categories of male individuals admitted to the Royal London Hospital due to fracture

Body Area	**AF**	**Trd**	**Lbr**	**Agr**	**Ind**	**Ser**	**Misc***
Cranial	4 (9.1%)	2 (3.6%)	6 (4.7%)	0	0	2 (7.1%)	1 (7.7%)
Torso	4 (9.1%)	11 (20.0%)	25 (19.7%)	3 (30.0%)	0	5 (17.9%)	1 (7.7%)
Arm	6 (13.6%)	10 (18.2%)	23 (18.1%)	2 (20.0%)	0	1 (3.6%)	2 (15.4%)
Hand	0	0	0	0	0	0	0
Leg	29 (65.9%)	32 (58.2%)	72 (56.7%)	5 (50.0%)	1 (100.0%)	20 (71.4%)	9 (69.2%)
Foot	1 (2.3%)	0	1 (0.8%)	0	0	0	0
Total	**44**	**55**	**127**	**10**	**1**	**28**	**13**

* AF = armed forces; Trd = Tradesman; Lbr = Labourer; Agr = Agriculture; Ind = Industrial; Ser = Servant; Misc = Miscellaneous. Values in parentheses are percentages: number of individuals in occupation category with fractured body area / total number of individuals in occupation category.

Table 6.11 Occupation categories of female individuals admitted to the Royal London Hospital due to fracture

Body Area	AF Wife	Trd Wife	Lbr Wife	Ser Wife	Ser	Lab	Trdw	Widow	Nurse	Misc*
Cranial	0	0	0	0	0	0	0	1 (6.7%)	0	0
Torso	0	0	0	0	2 (12.5%)	2 (12.5%)	0	3 (20.0%)	0	0
Arm	1 (20.0%)	7 (46.7%)	4 (28.6%)	0	2 (12.5%)	2 (12.5%)	0	2 (13.3%)	1 (20.0%)	0
Hand	0	0	0	0	0	0	0	0	0	0
Leg	4 (80.0%)	8 (53.3%)	10 (71.4%)	4 (100.0%)	12 (75.0%)	12 (75.0%)	4 (100.0%)	9 (60.0%)	4 (80.0%)	3 (100.0%)
Foot	0	0	0	0	0	0	0	0	0	0
Total	5	15	14	4	16	16	4	15	5	3

* AF Wife = Armed Forces Wife; Trd Wife = Tradesman's Wife; Lbr Wife = Labourer's Wife; Ser Wife = Servant's Wife; Ser = Servant; Lab = Labourer; Trdw = Tradeswoman; Misc = Miscellaneous + Beggar. Values in parentheses are percentages: number of individuals in occupation category with fractured body area / total number of individuals in occupation category.

These results demonstrate the seemingly infinite variety of circumstances in which individuals might suffer a fracture. The risks inherent in an individual's occupation may or may not have been a factor in their fracture incident. For instance, on 21 November 1791 William Owen, a 40-year-old confectioner, was admitted to the Royal London with an arm fracture and died two days later in the hospital. In contrast, Robert Moore, a 33-year-old labourer working as a sawyer was admitted to the Royal London with an arm fracture on 26 September 1791. He discharged himself on 28 October 1791, staying 33 days in hospital. What was it about the arm fracture of the candy maker versus the labourer that proved fatal? Neither arm fracture is labeled as compound, but clearly there were complications arising in the confectioner's case that lead to death. Richard Crews, a 30-year-old sailor from Whitechapel suffered a leg fracture, but was discharged 38 days later. Justice Smith, a clergyman, fractured his leg and was admitted to the Royal

London on 20 June 1760, dying 11 days later. These examples illustrate that the routine activities of an individual's occupation may or may not have been related to their fracture. It is likely that shock and infection played a role in these fatal cases.

The physicians' and surgeons' casebooks make reference to fractures that are clearly infected, either by describing the colour of the wound or referring to the presence of pus. Thomas Herne entered St. George's Hospital with a compound fracture of his right tibia and fibula. Two days after his admission, the wound and treatment are described: "the edges of the wound were discoloured, as if having a tendency to gangrene. A stale-beer Poultice was applied" (RCS, MS0470, Vol. 1, p. 45). Nehemiah Fry suffered a compound fracture of the left tibia and fibula; nine days after his admission Benjamin Brodie notes that "there was a great discharge of pus" (RCS, MS0470, 44, pp. 147-149). An unnamed gentleman was admitted to St. Bartholomew's hospital after a stay in Bedlam hospital; upon autopsy it was discovered that he had a variety of fractures, including "the sixth true rib [which] was found broken and surrounded with pus in the situation of the fracture" (MR 16/1, p. 30).

Robert Campbell's 1747 treatise on occupations and their associated working conditions in London provides a snapshot of hazards that were commonly encountered by various professions. He writes dispassionately about the relative physical strength and mental prowess required to successfully complete various occupations. A needle or pin-maker apparently "does not require to be so acute as the Instruments he makes" (1747, p. 256), while tailoring specializing in children's coats is an area "chiefly engrossed by Women, who make a good Living of it: It requires a tolerable Genius, but not much

Strength" (p. 226). Physically demanding trades such as iron foundry require "a strong Constitution and a robust Body, to undergo the Heat of Fire, &c" (1747, p. 179). Specialists and tradesmen are described individually; in contrast, those described as "common labourers" were clearly non-specialized workers whose skills rank lower than the tradesmen. The data in Table 6.10 show that labourers outnumber tradesman in each fracture category. This suggests that labourers were likely undertaking more hazardous work. Indeed, there is evidence that the labourer group suffered many dramatic occupational accidents, such as James Collins, age 38, who was admitted to St. Bartholomew's with a fractured skull. His accident "was occasioned by falling from a height of 20 ft with a heavy piece of Iron which fell across his back when he reached the ground" (RCS, MS0470 49, p. 221).

Clinical European studies concerning craniofacial trauma and contemporary occupations have discovered varying trends. Eggensperger, Danz, Heinz, & Lizuka (2006) conducted a three-year investigation and found that older male (mean age 44.4 years) farm and forestry workers were the most frequently injured group. Fractures to the midface and skull caused by falling, thrown, or projected objects were the most common. Hächl et al. (2002)'s sample included construction workers, craftsmen, and office employees. Affected individuals were most likely to be males between the ages of 20 and 29; maxillofacial injuries were caused by blows to the face, falls, or falling over obstacles. The construction workers and craftsmen suffered more injuries than the office workers. Boston, Witkin, Boyle, & Wilkinson's (2008) work concerns individuals excavated from the Old Burial Ground of the Royal Hospital Greenwich (dated to 1749-

1857). These 97 males were sailors or marines in the British Royal Navy during the eighteenth century. The majority of these individuals (n=82, 84.5%) had at least one antemortem fracture (Boston et al., 2008). This result is significantly higher than the male skeletal sample in the present research (n=188, 46.7%). Boston et al. (2008) propose that occupational hazards to the sailors, such as falls from the rigging and swinging booms were likely causes of many of the fractures discovered in the sample. The true prevalence rate for fractured nasals in the sailor sample is 61.8%, compared to the 13.0% true prevalence rate found in the male skeletal sample in this research. This result demonstrates that certain occupations may be linked with a particular pattern of behavior that influences fractures. Adkins and Adkins (2009) outline the popularity of boxing among sailors and marines, as well as their penchant for alcohol-fuelled assaults during shore leave, two behaviours that likely contributed to nasal and maxillary fractures. In the present study no particular skeleton was linked to evidence of any particular occupation.

6.5 PERIMORTEM TRAUMA

As discussed in Chapter 3, the differentiation of perimortem trauma from postmortem damage to a bone is challenging. There were four perimortem fractures, in three individuals, identified in the skeletal sample, all present in the Royal London Hospital skeletal assemblage. These fractures displayed a combination of perimortem features, such as consistent colouring, sharp fracture edges, and lack of bony healing response. Three of the fractures involved the lower limb (two tibiae, one fibula), and the fourth was a fracture of the radial head.

Two individuals displayed perimortem fractures to the proximal tibial surface. There is a sharp-edged depression to a fragment of the lateral tibial plateau of individual RLP05 247, an older female. The medial tibial condyle of individual RLP05 398, an adult male, displays evidence of an antemortem injury; there is an irregular, lytic lesion with a dense trabecular response. The lateral condyle has a perimortem hairline fracture; it is possible the joint was weakened by the previous injury to the tibia, resulting in the perimortem injury. As Wedel and Galloway (2014) note, the tibia "has the unfortunate position of being a weight-bearing bone attached to two vulnerable joints" (p. 273) with the proximal end comprised primarily of cancellous bone. Tibial plateau fractures are generally caused by abduction of the tibia whilst it is under compression from the femur (Kennedy & Bailey, 1968). Clinically, these fractures, caused by vertical compression or twisting of the limb, mostly affect the elderly since the femoral condyles do not weaken over time as progressively as the tibial condyles. The majority of tibial plateau fractures occur to the lateral condyle (Manaster & Andrews, 1994); according to Resnick (2002), between 75 and 80% of these fractures occur to the lateral condyle. Clinically, between 25 and 52% of tibial plateau fractures occur due to collisions with cars (e.g., Dovey & Heerfordt, 1971; Hohl, Johnson, & Wiss, 1974; Reibel & Wade, 1962). Other causes include falls from heights and blunt blows to the joint (Wedel & Galloway, 2014).

Two male individuals, Augustin Aldred (age 38) and Henry Wake (age 53) were admitted to St. George's Hospital with fractures "of the head of the Tibia, just above the articulation of the Fibula sloping upwards into the joint" (RCS, MS0470 51, p. 127). Both were caused by falls from horses. These individuals survived the injuries and were discharged from hospital, but both suffered from severe ecchymosis and swelling of the knee during their hospital stay. Though it cannot be determined if the fractures were specifically of the tibia, male individuals with leg fractures died in only 2.7% of cases at the Royal London and Middlesex hospitals (Appendix C, Table C.15).

Individual RLP05 398 also had a comminuted perimortem fracture to the humeral surface of the radial head with no evidence of healing. Elbow injuries often cause fractures to the head and neck of the radius (Rogers, 1992; Teasdall, Savoie, & Hughes, 1993). Proximal radial fractures vary with age (Green & Swiontkowski, 1994) and the radial head is more commonly involved in elbow injuries in adults than children (Alffram & Bauer, 1962). Radial head fractures occur when indirect force is transmitted during falls onto an outstretched hand, particularly when the elbow is partially flexed and the forearm pronated (DeLee, Green, & Wilkins, 1984). Clinically, Schatzker (1987) has outlined three categories of radial head fractures; individual RLP05 398 may fit into either category two, an impaction fracture with crushing and some comminution, or category three, severely comminuted fractures. This individual also had a perimortem fracture to the right tibia; it is possible that the two injuries occurred concurrently.

Individual RLP05 138, a male individual in the older middle adult category has a horizontal step on the superior aspect of the distal right fibular articular surface. Though the fibula does not have a major role in supporting the body's weight, during walking the lateral malleolus may carry a measure of body weight (Bolin, 1961). Fractures associated with supination-adduction of the ankle are usually transverse and located at the level of the talus's superior surface (Lauge-Hansen, 1948, 1950; Trafton et al., 1992). Unlike classic Lauge-Hansen fractures, however, the fracture did not extend throughout the entire lateral malleolus. There was no associated damage to the distal tibia or talus. Clinically, the fibula becomes susceptible to fractures in elderly individuals due to loss of bone density (e.g., Hasselman et al., 2003; Kelsey et al., 2006), thought it is also vulnerable to direct blows, and the majority of fibular fractures arise in athletes (e.g., Slauterbeck et al., 1995). As mentioned in Chapter 5 in reference to ankle fracture, Thomas Norris suffered a perimortem fracture to his ankle. The surgical records indicate that in addition to fracturing the "internal and external Malleoli of the right leg" Norris had managed to lacerate the tibial artery (St. B, MR16/4, p. 148). His leg became swollen and ecchymosed, and he became increasingly pale and haggard before his death three days after the fracture occurred.

Fatal cases of fracture were recorded in both the Royal London and Middlesex Hospital admission records and the surgical notebooks consulted. There were, however, only four examples of perimortem trauma observed in the skeletal sample, all of which appeared in the Royal London Hospital skeletal sample. Acute emergency cases were accepted to the Royal London Hospital without a governor's letter at any time (Clark-Kennedy, 1962) and Fowler and Powers (2012) cite articles from *The Times* which describe the important emergency function of the Royal London Hospital. The perimortem fractures found in the Royal London Hospital skeletal sample allow for direct comparisons with clinical materials and other palaeopathological reports from hospital assemblages (e.g., Western, 2010). Individuals admitted to hospital with any fractured element were more likely to be discharged or made an outpatient than to die in hospital according to the admission records for the Royal London and Middlesex hospitals; however, these examples of perimortem trauma provide tangible examples of the types of fatal accidents described in the contemporary surgical casebooks.

As discussed above (Table 6.5), there were 14 individuals with multiple fractures in various stages of healing. The most dramatic example was RLP05 124, an older male individual who had two healed rib fractures, a healed fracture to the right metatarsal four, and a healing right midshaft spiral femoral fracture. There is a non-displaced butterfly segment present and a small amount of new bone formation, suggesting this individual remained in hospital for some weeks before his death (following De Boer et al., 2015). Fractures to the femoral shaft suggest that considerable force was applied to the limb; the femoral shaft is among the most heavily mineralized elements in the skeleton (Galloway, Willey, & Snyder, 1997). In adults, the majority of femoral fractures appear in the middle third of the shaft (62.5%; Winquist, Hansen, & Clawson, 1984), and are usually caused by falls from a height, motor vehicle accidents, car-pedestrian accidents, and plane crashes (Arneson, Melton, Lewallen, & O'Fallon, 1988; Johnson, 1992; Mooney & Claudi, 1984; Taylor, Banerjee, & Alpar, 1994; Tencer et al., 2002; Winquist et al., 1984). As age increases, however, the energy required to fracture the femoral shaft decreases (Johnson, 1992). Huge blood loss is associated with shaft fractures (Mooney & Claudi, 1984).

John Hughes, age 27, suffered a compound fracture of the femoral shaft due to "a large woolsack falling on him off a waggon which knocked him down with great violence his leg being bent under him" (RCS, MS0470 51, p. 70). The surgeon notes that "much blood was lost on the way" (RCS, MS0470 51, p. 70) and that he died five days after the incident. The femoral shaft fracture found in RLP05 124 would have caused a massive shock to the body due to the associated loss of blood. Brodie records the case of a man with a fractured femur and pelvis, observing that "the shock of so severe an accident, however, many be sufficient to account for death" (RCS, MS0470 62, p. 65). It is not, therefore, unexpected to find limited signs of healing present in individual RLP05 124. Male individuals who were admitted to the Royal London or the Middlesex with a closed thigh fracture (for whom a result was listed) died in hospital in 6.2% (n = 161) of cases (Appendix C, Table C.15). Compound fractures of the thigh and leg (n = 2) resulted in a fatality rate of 50.0%, a statistically significant higher proportion than closed fractures of the thigh and leg (Appendix C, Table C.15).

6.6 SUMMARY

In this chapter possible causes of the fractures observed in the skeletal sample were explored; the majority likely occurred due to accidents, falls, and incidents of interpersonal violence. Individuals with multiple fractures and fracture recidivists were found in the skeletal sample. There were also 22 individuals identified in the hospital admissions records that may be recidivists. Incidents of interpersonal violence are likely responsible for the high frequency of nasal and metacarpal fractures in the male skeletal sample. The cultural importance of masculinity and the popularity of boxing are suggested as likely explanations for this fracture patterning. Data on hospital patients' occupations were examined and, in this sample, it is evident that labourers more frequently suffered fractures than tradesmen. The four examples of perimortem trauma found in the skeletal sample are likely tied to the individuals' deaths in hospital since there are no signs of healing present.

Chapter 7.0 – ENGAGING WITH DISPARATE DATASETS

7.1 INTRODUCTION

In this chapter I outline the difficulty of ensuring that comparisons between datasets are justified, and the challenges of incorporating historical and contemporary medical data. The limitations in skeletal aging techniques are addressed in reference to how they limit interpretations in the present study. The representativeness of both the skeletal and archival samples are outlined. The possibility of accessing past individual's personal choices regarding hospitals is addressed. The errors and biases in the historical record are examined in relation to the present study.

The guiding question becomes: if only one source of data were available, what version or view of the past would be accessible?

7.2 CHALLENGES AND BENEFITS OF ENGAGING WITH DISPARATE DATASETS

7.2.1 Comparing like with like

A major challenge associated with incorporating disparate lines of data is ensuring that comparisons between datasets are sensible and will answer one's research questions. It is crucial to let the collected data dictate which statistical tests are possible or appropriate. Asking a simple query such as: "what areas of the body were the working poor in London fracturing most frequently during the 'long' eighteenth century?" becomes increasingly complicated as the various lines of data are explored. The challenge is ensuring that one is comparing like with like and using appropriate statistical tests for which all test requirements are fulfilled. I would venture to suggest that researchers should collect the largest dataset possible according to the “aims of the enquiry” (Drake, 1982, p. x) so that the fewest statistical interventions are necessary to make meaning of the data.

When investigating skeletal evidence, bioarchaeologists examine both the crude and true prevalence of a certain attribute, such as the presence or absence of fractures. Lovejoy and Heiple’s (1981) landmark quantitative study of fractures encouraged the use of true prevalence and increasingly authors are following their example (e.g., Brickley, Buteux, Adams, & Cherrington, 2006; Roberts & Cox, 2003), allowing for large-scale cross-site comparisons to be made. This method was employed in the present study to probe whether or not there were significant differences in the prevalence of fractures between sided elements, hospital and parochial skeletal samples, or between males and females. In the current research it was appropriate to employ Chi-square statistical tests in the skeletal dataset because fractures were recorded in detail and element counts for each bone had been collected. The historical admission records demanded a different approach since the admission records do not provide information concerning which sided element was fractured or what area of the bone was fractured. I decided, therefore, to compare the difference between the two proportions (Fletcher & Lock, 2005, pp. 98-100) and the most frequently observed and/or admitted fractures with the Spearman’s rank correlation test, since these could be represented as ordinal ranks (Fletcher & Lock, 2005, pp. 123-126). These tests demonstrate that the most common fractures appearing in the skeletal record are different from those most commonly being admitted to the voluntary hospitals.

Despite the difficulty in directly comparing the datasets, it is clear that each line of evidence tells a different story relating to fractures.

As discussed in Chapter 3, the clinical understanding of fractures common to eighteenth-century physicians and surgeons has clear analogues in contemporary biomedical and bioarchaeological definitions of trauma. Further, fracture admissions do not share the social stigma of a disease like leprosy or syphilis, the vague diagnosis of conditions such as old age, or symptomatic diagnosis (e.g., fever, cough) (Sawchuk & Burke, 2003). The incorporation of clinical data is a crucial step in placing fractures in their biomedical context. In palaeopathology, fractures are particularly useful links to the past since they have a predictable and well-understood effect on bone; infectious diseases may take years of chronic infection to cause bony changes or, in some cases, never affect the skeleton. Fractures are not, however, a magic bullet – there are limitations that must be considered when creating a research program.

Clinically-derived epidemiological data are an excellent datasource for comparison in bioarchaeological studies. Studies of trauma, in particular, provide a direct link between bioarchaeological and clinical research (e.g., Glencross & Stuart-Macadam, 2000; Matos, 2009) with studies of bone mass (e.g., Clark, Ness, Bishop, & Tobias, 2006; Clark, Ness, & Tobias, 2008) and geometry (Taes et al., 2010) applicable to bioarchaeological questions. Many studies incorporate discussions of fractures secondary to osteoporosis (e.g., Black & Cooper, 2000; Donaldson et al., 1990; Heyse, Sartori, & Crepaldi, 1990; Kanis, Johnell, Oden, de Laet, & Mellstrom, 2004; Sharma, Fraser, Lovell, Reece, & McLellan, 2008); these studies are crucial to understanding the effects of age and loss of bone mass on fracture risk in past communities. Epidemiological studies of fractures have limitations, such as underestimation of overall incidence due to underreporting, the overestimation of certain fractures due to inexperienced physicians' overdiagnosis, and the skewing of results due to all data being derived from one hospital location (Moore & Clark, 2008; Singer et al., 1998; Wynn et al., 2001). These problems are not unique to contemporary clinical data – the historical hospital admissions data also potentially suffer from these issues. Statistician Joseph Berkson (1946) described the selection bias inherent in hospital data, noting that

> various circumstances, such as the severity of the symptoms, the amenability of the disease to treatment by a local physician or the reputation of a particular hospital for treatment of particular diseases, will determine the probability that a specific disease will bring its victim to a particular hospital (p. 49).

Berkson's concerns about the biases of hospital-based data could be extended to both the voluntary hospitals of the "long" eighteenth century and clinical data collected today. Individuals make the choice whether or not to visit the hospital and it is this choice that both biases the data and provides a tantalizing glimpse at the choices made by people in the past.

Ultimately, if the research parameters and limitations are clearly outlined then documentary evidence can be incorporated into bioarchaeological studies. Even if direct comparisons are not appropriate, documentary evidence may be used as ancillary support.

7.2.2 The revelation of personal choice

The two datasets analyzed in this study represent different aspects of an individual's experience of fracturing a bone. The skeletal dataset comprises, in the majority of cases, antemortem fractures, or injuries that had sufficient time to callus and remodel. These fractures were clearly not fatal and may or may not have continued to affect an individual's ability to ambulate, gesticulate, and complete their occupation. In contrast, the hospital admission registers capture a moment in an individual's life when they were motivated by their fracture to take action to relieve their discomfort. The injuries recorded in the admission registers are acute, recent, and affecting an individual's immediate health and wellbeing.

Not all individuals who suffered a fracture sought hospital treatment. The thriving medical marketplace of the "long" eighteenth century meant that patients had the power to choose their practitioners. Many individuals sought the aid of a bonesetter, other alternative practitioners, or treated their injuries at home. Ill individuals could choose the services of many practitioners and their independence was heightened by the publication of self-help tomes such as John Wesley's *Primitive Physick* (1747), which championed natural holism and cold water therapy, and William Buchan's *Domestic Medicine* (1769), which proposed a philosophy of health based upon hygiene and temperance (Porter 1992b). These volumes, published in English rather than Latin to appeal to a lay medical audience, went through many editions, indicating the popularity of self-help. Followers of Buchan's volume were so numerous they were dubbed his "Buchaneers" (Porter & Porter, 1989, p. 199). In some cases, individuals may have desired hospital treatment, but been unable to secure a governor's recommendation. Still others may have been fearful of the hospital; William Buchan wrote about the "preconceived fears and anxieties" of the poor concerning admittance to a hospital (Risse, 1986, p. 25). Contemporary characterizations of nursing staff as frequently drunk and underprepared are revealed through remarks in historical documents, such as this marginal note in the Middlesex apothecary register: "Mr. Brown the House Surgeon complains of Nurse Bruce behaving very insolent to him when he reprimanded her for being drunk & incapable to do her duty" (UCL, 14 December 1784, Volume 4). Joseph Wilde (1810) describes his nurse as a "Fury in a human shape" whose "tongue kills more than ablest doctors cure" (p. 58), suggesting that not all medical staff treated patients with patience. There were rumours that surgeons undertook unnecessary amputations, a fear not quelled by writers such as John Aikin asserting that the working poor were perfect for "experimental practice" (1771, p. 76). Howie (1981) characterizes inpatients as "highly vulnerable, and wholly at the mercy of those who cared for them" (p. 345). These generalizations about the quality of hospital care and the bad reputation of its food (Howie, 1981) may have discouraged some from seeking hospital admission.

The intangible notion of human choice is represented in the results of this research. Minor injuries to the fingers and toes outrank major femoral fractures in the skeletal remains; essentially the opposite result is found in the hospital admissions registers. It is possible that individuals may not have realized that they had suffered a fracture to their digits or to their vertebrae; the clinical literature suggests there is massive underdiagnosis of spinal fractures (Delmas et al., 2005; Lentle et al., 2007) due to a lack of severe symptoms. These results reveal personal choices made in the past in reference to an individual's health. In some cases individuals did not make their own choice to go to hospital, perhaps because they were injured in a public place, particularly in the case of accidents involving vehicles, and were rushed to a hospital by friends or bystanders. These victims were often unconscious or "perfectly insensible," such as William Wheatley, admitted to the Westminster Hospital with a skull fracture (RCS, MS0162, n.p.) or John West, admitted to St. George's, having been "found quite insensible" having been "thrown from off a stage coach and pitched upon his head" (RCS, MS0470 62, p. 31). In most cases, however, individuals deal with the situation described by Joseph Wilde (1810), who, upon arriving at the hospital, found "himself amongst a crowd / Of wretched candidates to gain admission; / Each recommended by some kind subscriber" (p. 6). Wilde was nearly rejected due to his lack of governor or subscriber's recommendation, "alas! [he] had fail'd through lack of forms / And now, his long, and agonizing journey / Had all abortive prov'd" (1810, p. 6). Thankfully, Wilde managed to connect with "a friend—and one more true, / Or swifter to obey the call of pity, / Ne'er trod the earth…So should the name of PEAR, the parish clerk, / Descend to ages" (1810, p. 5); this individual secured Wilde the appropriate recommendation paperwork. An individual's admission depended upon their own decision to seek treatment, the recommendation of a third party, and the acceptance of the admissions board.

The incorporation of historical records adds colour and detail to the study of the individuals who suffered fractures in the past. Descriptions of patients that go beyond symptomology allows for an interrogation of their reactions to their treatment. In some cases, glimpses of past personalities may be perceptible. There is a range of reactions recorded. Some include harrowing descriptions of patients' pain, fear, and confusion:

> [T]he lower limbs are paralyzed he moans & calls out constantly & seems to suffer much from the back, trying to force himself up
> (RCS, MS0470 49, p. 221).

> The excessive sensibility was chiefly referable to the lower extremities when the slightest touch seems to produce as much excruciating pain as a wound with a sharp instrument
> (St. B, MR 14/14, n.p.).

In other cases, patients descend into delirium, only to have their ravings recorded for posterity:

> There was constant restlessness, with wandering ideas, spectral delusions, and unceasing loquacity. He said that he was surrounded by butterflies, and fancied that soldiers were behind the door, & that he was conversing with some of his absent acquaintances
> (St. B, MR/8, n.p.).

> [H]e continued to rave and imagined himself surrounded by as many evil spirits as there were patients and persons in the ward accused the house-surgeon (who was the chief in authority present) as being the Arch Fiend – For one hour he remained calm and quiet describing the horrors of hell that had been present to him, he then became more furious and was ordered to be strapped down, the visions of hell again returned to him and the house surgeon under he conjured as Satan not to approach him in the name of God… At 5 AM June. 4 he fancied himself at Newport that the tide was coming in and surrounding him, his shrieks now became quite awful
> (St. B, MR 16/1, pp. 33-34).

Other patients recover steadily and are impatient to leave hospital, or refuse to follow the physicians' and surgeons' orders. For instance, Jim Simon Steitz had fractured his fibula and dislocated his ankle; despite a considerable deformity the patient claimed he felt no pain. He spent at least six weeks in hospital with his foot and leg being treated with splints and bandages "which he frequently loosened or removed" (St. B, MR/8, n.p.). Another patient:

> could not be persuaded to keep his bed more than three weeks & in twenty five days from the time of fracture he left the hospital, he informed me that his leg had been fractured about twenty years ago & that he was able to stand on it at the end of three weeks" (RCS, MS0162, n.p.).

In contrast to the above examples, some injuries produced only quiet and calm in a patient. Thomas Wetherall, age 50, was admitted to St. George's Hospital with a fractured cervical vertebra. He had been driving under an archway, but did not stoop low enough to clear the archway, and his neck was violently bent back upon contact. He remained sensible during his day-long stay in the hospital and it was that "he died about 8 oClock p:m: he was perfectly sensible to the last minute. Complained of no pain, but said that he felt very sleepy" (RCS, MS0470 62, p. 100).

It is crucial to recall that the individuals who appear in skeletal samples were once living individuals who experienced a potentially painful, debilitating, and frustrating injury. The experience of the surgeons charged with treating individuals is another critical aspect to consider. William Chamberlaine, wrote a warning to apprentice surgeons in 1812, demanding:

> Are you too fine a gentleman to think of contaminating your fingers by administering a clyster to a poor man, or a rich man, or a child dangerously ill when no nurse can be found that knows anything of the matter? This is a part of your profession that it is as necessary for you to know how to perform as it is to bleed or to dress a wound…Or are your olfactory nerves so delicate that you cannot avoid turning sick when dressing an old neglected ulcer; or when, in removing dressings, your nose is assailed with the effluvia from a carious bone? If you cannot bear these things, put Surgery out of your head and go and be apprentice to a Man Milliner or Perfumer (pp. 51-52).

The incorporation of available documentary evidence is of immeasurable benefit to the reconstruction of past fracture experiences.

7.2.3 Age estimation

Age estimation limitations are a chronic plague upon bioarchaeological studies. The ability to correlate osteological and clinical data is hindered by this challenge (Glencross, 2011; Glencross & Sawchuk, 2003) and much attention has been paid to exploring the limitations in determining age distributions from skeletal samples (e.g., Hoppa & Vaupel, 2002). The broad age categories used in skeletal studies are necessary since aging individuals who have passed puberty is an imprecise matter of examining macroscopic degenerative changes present in various aspects of the skeleton. Jackes (2000) explores various statistical, histological, and macroscopic methods of age estimation, acknowledging that "as yet we have no firm solutions to the problem of adult age assessment" (p. 451) and Kemkes-Grottenthaler (2002) notes that "the quest for the perfect aging standard remains futile" (p. 65). Jackes (2000) encourages the separation of indicator stages of degenerative change in the skeleton from specific age categories, suggesting that changes in the skeleton may be used as "ways to understand how the human skeleton responds to the exigencies of adult life under many circumstances" (p. 455).

Chronological age in the hospital records is more easily accessible. If a patient's age was not recorded, the categories were even broader than those of skeletal estimations: an individual could only be labeled as a juvenile, an adult, or unknown. When the age of the patient was listed; however, the hospital admissions dataset offers exactitude that a skeletal dataset cannot approach. As noted in Chapter 3, individuals in the past often did not know their exact age and that ages ending with zero or five were more likely to be recorded. Despite the poor Whipple index in the present study, it is still unlikely that individuals would mis-age themselves by a full generation, as is possible in skeletal estimates of age. The aged admission register sample in the present project comes from three years of extant documents. If the sample were larger, or more consecutive years were present, it would be appropriate to use a three-year moving average to diminish the bias introduced by age heaping (Chamberlain, 2006; Newell, 1988).

The ages recorded in the two types of data are inherently different. In skeletal studies we are estimating an individual's age at death, whereas the hospital records provide information on the chronological age of an individual when they arrived at the hospital with a fracture. Age-specific rates for non-fatal antemortem fractures are impossible to calculate (Waldron, 1991) since it is unclear at what age a fracture was incurred. This means that the ages of the 14 individuals with the healing and/or perimortem fractures (Table 6.5) are the key dataset with which to compare the age-related data drawn from the hospital admissions records. Of these 14 individuals, 11 were assigned to an age range while three were assessed only as "Adult." In Tables 7.1 and 7.2 the ages of individuals admitted to the Royal London Hospital for selected fractured elements (i.e., those recorded as either having a perimortem or healing fracture: ribs, femur, fibula, and tibia) are displayed.

Table 7.1 Age data array for individuals admitted to hospital with selected elements

Element	Males				Females			
	n	Mean	Mode	Range	n	Mean	Mode	Range
Rib	33	44.6	40	20-83	-		-	-
Femur	36	39.8	40	18-71	-		-	-
Fibula	3	36.7	N/A	27-47	-		-	-
Leg*	-	-	-	-	49	48.1	40	21-79

* - No admissions specifically for "tibia" were recorded in the Royal London Hospital for females; therefore, records indicating a "fractured leg" are included here for comparison.

Table 7.2 Summary of age data for individuals in skeletal sample with healing or perimortem fractures

Age Category	Male			Female
	Rib	Femur	Fibula	Tibia
MA1* (26-35 years)	1 (12.5)	0	0	0
MA2 (36-45 years)	5 (62.5)	0	1	0
OA (46+ years)	2 (25.0)	1 (100.0)	0	1 (100.0)
Total	8	1	1	1

* MA1 = middle adult 1; MA2 = middle adult 2; OA = older adult. The values in parentheses are percentages.

Despite the small sample size, it is possible to discern some relationships between the datasets. The majority (5/8 = 62.5%) of the male individuals with healing rib fractures fell in the MA2 (Table 6.5); these categories encompass the average of 44.6 years and mode age value of 40 for a male individual seeking hospital care for a fractured rib. The female results for leg fractures have an average of 48.1 years, which corresponds to the perimortem tibial plateau fracture in female individual RLP05 247, who was classified as an older adult. It should be noted, however, that the most commonly reported age for females entering hospital with a fractured leg was 40. The male fibular result of 36.7 years matches the MA2 age category. Male individual RLP05 124, who had a healing femoral shaft fracture, was categorized as an older adult; this result does not match the average age of admission in the Royal London admission records of 39.8 years, but the range of ages at admission for femoral fracture extended from 18-71, encompassing the YA to OA categories and limiting the age-related conclusions that may be drawn.

These results demonstrate that there is some correspondence between the ages at which individuals most commonly sought hospital care for a particular fractured element and the skeletal evidence for healing or perimortem fractures. Further research into the correspondence between these two lines of data in particular age categories would be useful to investigate whether the skeletal samples and admissions records consulted in this research have yielded typical or average results.

7.2.4 Representativeness of sample

Skeletal samples are the remains of a group of individuals representing a small segment of a once-living population. A population may be defined biologically as a "bounded group of living individuals" (Chamberlain, 2006, p. 1) or socioculturally as a social unit in which individuals are linked by their cultural affinity, language, and geographic location (Kreager, 1997). A skeletal sample will never represent the total numbers of deaths in a population during the temporal period under investigation (Alesan et al., 1999; Boddington, 1987). Bioarchaeologists are therefore tasked with determining how representative a skeletal sample is of the larger skeletal group from which it is drawn and, if possible, of the living population it represents. It is, unfortunately, impossible to be certain whether the excavated, curated, or consulted skeletal sample is actually representative of the living population due to various taphonomic, demographic, and cultural factors (Hoppa, 2002; Nawrocki, 1995; Waldron, 1994). A cemetery population is clearly not the same as a living population and must not be assumed to be a homogenous cohort (Grauer & McNamara, 1995). Cemeteries are cumulative samples that comprise deaths over a period of time (Larsen et al., 1995) and contain non-survivors (Wood et al., 1992).

Issues concerning representation have been puzzled over in anthropological texts such as *Grave Reflections* (Saunders & Herring, 1995), wherein issues of excavation bias, skeletal sample size, and the potential of making general statements about past communities are explored. In the execution of this project, I aimed to observe the maximum number of individuals possible from cemeteries known to contain individuals of the working class in an attempt to lessen the sociocultural and locational bias that would come from any individual cemetery sample.

Similarly, the hospital admissions sample gleaned from the available archival holdings may not be representative of the larger population. A representative sample from a living population would draw from a random sampling of individuals where each individual in the population has an equal chance of being selected. In this case, the randomness was introduced through which hospital admission records had survived to be curated. Each archive had a unique system of identifying and storing the historical documents. In one unfortunate case, a volume I requested for consultation was listed on the archive's website, but was discovered to have been lost. All identified records were consulted in order to ensure that the sample was as representative as possible of the larger population. The unique style of recording and range of data categories utilized at each hospital in the registration process affected the comparability and completeness of the research sample. Function followed form, meaning that topics such as length of hospital stay and possible cases of multiple admissions could be investigated at all hospitals, whereas the frequency and annual patterning of fracture types could only be drawn from the Middlesex and Royal London hospital records.

The dataset available may not be representative of the total population of London, but careful analysis and the honest, upfront addressing of limitations means that general patterns and evidence of certain behaviour patterns, such as interpersonal violence, may still be elucidated. Future work involving comparisons with rural skeletal samples, following the example of Judd and Roberts (1999), would be useful to understand if the results are particular to an urban environment. As Cannon (1995) states, in his study of material culture and palaeodemography, "documentary, osteological and material culture evidence trace three distinctive though not mutually exclusive trajectories of population history" (p. 14).

7.2.5 Human error in the records

Humans make mistakes. The anonymous clerks recording hospital admissions frequently spelled names inconsistently, missed information such as reasons for admission, and added up totals incorrectly. I found these types of errors in the admission records and attempted to correct or alter them as I went along. There is, however, the possibility that historical mistakes could remain undetected in the data. Risse (1986) details how the expansion and consequent increased registration at the Royal Infirmary of Edinburgh caused the hospital clerks to become overwhelmed. Certain admission papers went missing or information was not transferred due to the clerks having "too much business" (Royal Infirmary of Edinburgh, Minute Books, Vol. 4, 1770, p. 227). Grauer characterizes human record keeping as "overwhelmingly erratic" (1995, p. ix). Higgins (2003) acknowledges the role of human oversight in incomplete records, stating that 19 years of natality data are missing from the Erie County Almshouse records simply because "the poorhouse keepers failed to record them" (p. 80). Similarly, Sawchuk and Burke (2003) reveal that contemporary observers of a nineteenth century cholera outbreak had "no easy consensus regarding the total number of cases and deaths" (p. 182). Moran (1986) and Anderson (1988) detail various compounded errors present in nineteenth-century American census data due to enumerators' oversights. Allowing adequate time to untangle the threads of historical documentation is key to catching possible errors. Mitchell (2012) emphasizes the importance of studying primary documents to understand "who wrote them, why they were written, for whom they were written, and exactly when they were written" (p. 316). Thankfully, the motivation of hospital record keepers is clear and the documents were dated. Reasonable expectations for how accurately historical documentation reflects historical reality are necessary. As Saunders, Herring, Sawchuk, and Boyce (1995) state, "past life can only be accurately represented from written records if these are well-preserved, adequately detailed and in sufficient quantity" (p. 99). Various cautions have been highlighted and Cox (1995) warns that anthropological researchers should not accept information in historical documents without question.

The biology of poverty has been investigated by a variety of researchers studying skeletal remains (e.g., Grauer & McNamara, 1995; Higgins & Sirianni, 1995; Phillips, 2001; Sirianni & Higgins, 1995; Steegmann, 1991; Wesolowsky, 1991). Phillips (2003) investigates similar questions as this research, investigating a "voiceless group," an asylum skeletal sample, and seeking to "test hypotheses generated from the historical record" (p. 96). In Phillips' intriguing work, the documentary sources are used primarily as a qualitative source, adding social and historical context to the biomechanical measures taken from the skeletal sample. These papers demonstrate the depth and breadth of information that may be gleaned from the historical record concerning past lives.

7.3 SUMMARY

This research demonstrates that it is possible to discern human agency and choice through a comparison of skeletal and archival datasets. The common link is fractures. It is clear that not all fractures are made equal; the evidence described shows that factors such as fracture location, age, sex, and occupation affected individuals' decision to seek hospital admission. The incorporation of multiple datasets is certainly challenging, but "a focus on the complexity of the datasets should not detract from their value" (King, 2006, p. li). There are inherent limitations of each dataset in terms of estimating age, assessing representativeness, accounting for human error, and ensuring that like is being compared with like; however, the benefits of accessing past individuals' choices concerning health care should outweigh these challenges.

Chapter 8.0 – CONCLUSIONS and FUTURE RESEARCH DIRECTIONS

8.1 ADDRESSING THE AIMS & OBJECTIVES

In this research I have united data drawn from human skeletal remains and archival holdings relating to the seven general hospitals of London that operated during the "long" eighteenth century to obtain insights into the lives and fracture experiences of the working poor in London. Incorporating disparate lines of data is not a simple task. There are myriad limitations that must be addressed and considered; however, the existence of both skeletons and written records from the same limited temporal period is not a given in bioarchaeological research. Despite the inherent limitations in the datasets, this research has demonstrated that through using fractures as a common link between human skeletal remains and historical hospital admission records, it is possible to address aspects of human choice in the past concerning medical treatment. Each dataset contributes varied aspects to the story of the working poor's fracture experience. These insights were gleaned by investigating the following questions:

8.1.1 What relationships exist between the admissions and skeletal datasets?

The most exciting result to emerge from the comparisons of these datasets is the clear and statistically significant difference between the most frequently fractured body areas. At a macro level, the proportion of torso, hand, and foot fractures in both the male and female samples is significantly higher in the skeletal dataset. The proportion of leg fractures is significantly higher in both the male and female samples in the archival dataset. This difference shows a clear division between critical injuries and those that may be treated without the intervention of a physician or surgeon. It is impossible to know whether particular individuals sought help from an alternative practitioner or treated themselves, but it is evident that not all fractures were considered to be equally severe.

These results provide clues concerning human choices in the past regarding health care. Other than individuals who were delivered to the hospital insensible and unconscious, it was necessary for an individual to acquire the appropriate paperwork and arrive at their chosen hospital on the taking-in day. This process could be chaotic and stressful (Wilde, 1810) and voluntary hospitals had mixed reputations. Eighteenth-century reformer John Howard describes St. Thomas' Hospital with the juxtaposition: "There were *no water closets.* The bread *was excellent*" (qtd. in Williams, 1986, p. 99). Despite the ever-present menace of bed bugs – described in 1765 by Samuel Sharp, surgeon at Guy's Hospital as "frequently a greater evil to the patient than the malady for which he seeks a hospital" (qtd. in Williams, 1985, p. 101) – the number of hospital patients across London rose during the eighteenth century. Between 1734 and 1749, the number of hospital admissions rose from under 13,000 to over 38,000 (Malcolm, 1810). Public attitudes towards the perceived pecuniary desires of private physicians caused substantial competition in the medical marketplace (Digby, 1994; Porter, 1985b). The voluntary hospitals, despite the rigmarole involved in gaining admission, may have been viewed as a thrifty alternative for major fractures. Minor fractures, such as breaks in the fingers and toes, were clearly not viewed as common candidates for hospital care, where it was understood that an individual would lose wages.

The decision to seek hospital admission depended upon a complex nexus of factors including securing transport to the hospital's location, the hospital's reputation, acquiring a hospital governor's guarantee, weighing of the effect of possible wages lost, and determining whether or not an alternative practitioner could effectively treat the fracture at home. This bioarchaeological study lends credence to historians' examinations of attitudes concerning eighteenth-century hospital care and provides evidence to further studies of alternative medicine. Identifying which fractures were not commonly recorded in the hospital admission records provides a picture of which injuries were most commonly being treated in the home or with the assistance of other members of the medical marketplace.

8.1.2 What are the sex-based differences, if any, in fracture frequency in both the skeletal and admission record datasets?

Fractures were found in both male and female individuals of all age categories in both the skeletal and admission record datasets. In both datasets there was a higher prevalence of fractures among males than females. Ribs, thoracic vertebrae, and proximal manual phalanges ranked among the top five most commonly observed fractures in both the male and female skeletal datasets. The groups differed in that males had more nasal, first metacarpal, and fibular fractures than females, while fractures to the radius, ulna, and navicular ranked more highly among females. In the archival dataset, rankings of the most frequently fractured elements rankings were more similar, with leg/thigh/femur, arm, rib/ribs, and skull/head fractures appearing in both the male and female categories. Surgeons' and physicians' notes reveal that injuries occurred in a wide variety of circumstances, from accidents to episodes of interpersonal violence and abuse. Fractures appeared to accumulate throughout the life course, with the largest proportion of fractures being found in the older adult age categories, with the exception of the navicular in females and nasals in males.

These results reveal distinct differences between the lives of men and women of the working poor. The skeletal results demonstrate that males suffered more fractures than females overall and in different areas of the body. The archival results support this discovery, since more males than females sought hospital admission. There were also sex-based differences in the age at which male and female individuals sought hospital admission for certain categories of fracture (e.g., leg/femur/thigh, ribs). These results suggest that the risk of fracture for males and females differed throughout the life course. As discussed in Section 5.2, males and females most commonly sought hospital admission for similar fractured elements; this suggests that if a fracture was deemed sufficiently severe, hospital admission was considered the best option, regardless of an individual's sex or age.

8.1.3 Does the fracture patterning in the skeletal dataset provide putative evidence for possible interpersonal violence?

The male skeletal sample showed clear evidence of violence-related injuries; fractures to the nasal bones and metacarpals were among the most frequently fractured elements observed. The Bennett's and boxer's fractures discovered in the skeletal sample indicate that these individuals had struck an object with the clenched fist, possibly in an incident of interpersonal violence. In general, male violence stemmed from expressions of masculinity or acting "like a man" (Old Bailey, 1825). In addition, boxing was a popular pastime in eighteenth-century England; successful boxers were widely celebrated and the Prince of Wales bestowed patronage upon the sport in the 1780s. The ritualization of male violence may explain the patterns of violence-related injuries observed in the male skeletal sample.

I did not find evidence of the same violence-related injures in the female skeletal sample. It is possible that females were engaging in violent displays or suffering violent abuse at the hands of a man; indeed, there are many historical examples of both, such Captain James Newth, who was convicted in 1735 of murdering his wife by striking her with a cribbage board and violently stamping on her (described in Durston, 2013). Various historians have tackled issues surrounding female violence and criminality in the past (e.g., D'Cruze & Jackson, 2009; Durston, 2013; Feeley & Little, 1991; Hurl-Eamon, 2005; Hurl-Eamon & Lipsett-Rivera, 2007; Kilday, 2005, 2007; King, 2006), and the gendered differences in historical crime rates have been explored (Steffensmeier & Allan, 1996). The historical records provide rich and often disturbing details concerning violence perpetrated both by and against females, but the incidents are more difficult to categorize than those of the males, which more commonly involved defending masculine honour (Shoemaker, 2001). Explorations of female fighting styles in minor altercations during the eighteenth century emphasize that scratching, biting, and throwing excrement from chamberpots were strategies primarily employed by women (Bailey, 2003; Warner, Graham, & Adlaf, 2005; Warner, 2008). None of these strategies were as likely to cause a fracture as the pugilistic tendencies favoured by most males during the period. The female skeletal evidence does not, therefore, provide as clear a picture as the males, since male patterns of behaviour were more likely to leave skeletal evidence.

Historical research concerning the position of women during the "long" eighteenth century in London will provide a basis for better understanding the relative position of the sexes. It is critical to assess structural violence, or entrenched political and economic inequalities, when examining both the origins and the use of violence (Galtung, 1990; Klaus, 2012; Martin, Harrod, & Fields, 2010; Redfern, 2015). Domestic abuse, or intimate partner violence, is a common form of violence against women (Martin & Harrod, 2015). Skeletal trauma, when placed in its wider ethnohistoric framework, may be used to examine potential victims of domestic abuse in the past (Duncan, 2012; Novak, 2006; Tung and Knudson, 2011). In the absence of adequate archaeological information, however, "bones do not always provide sufficient evidence to definitely identify [intimate partner violence] as opposed to other forms of violence against women" (Martin & Harrod, 2015, p. 131). McHugh and Hanson Frieze (2006) contend that women interact in different culturally modulated ways in different situations, thus women involved in violent encounters through time cannot be easily generalized. Ultimately, violence is fluid, and "always has a narrative dimension" (Crapanzano, 1986, p. 238).

8.1.4 What does the presence of perimortem trauma in the skeletal dataset reveal about fracture experience?

There were four perimortem fractures observed in three individuals, all discovered in the Royal London Hospital skeletal sample. These examples provide information concerning an individual's experience around the time of their death since these fractures can be compared to contemporary physicians' and surgeons' descriptions of individuals who suffered similar injuries. Investigating the individuals with multiple fractures (i.e., mixture of healed, healing, and perimortem) allows for a relative timeline of fracture events to be reconstructed. For example, from Table 6.3 it is evident that individual RLP05 138, a male in the MA2 age category, suffered fractures to his left and right nasal bones, his right os coxa, and three ribs during his life, all of which had sufficient time to heal before he incurred a right fibular fracture at or around the time of his death. Further research with other hospital skeletal samples will provide critical comparative data concerning which fractures were most likely to prove fatal in a hospital setting during the "long" eighteenth century. Individuals whose fates were recorded as having died in hospital in the admission records provide a baseline sample with which to contextualize these perimortem fractures.

8.1.5 What is the average length of stay in hospital as determined from the hospital admission records?

It was possible to track individual patients through their admission and eventual discharge from four of London's general hospitals. From these admissions I was able to discern the mean number of days spent in hospital before an individual was discharged as "cured," left of their own accord, or died in hospital. These data were used to describe the most frequently fractured elements found in the skeletal dataset. The length of stay in hospital for these elements lends further credence to the idea that individuals were choosing to enter hospital only for the most severe injuries. A male entering the Royal London, the Middlesex, St. Thomas', or Guy's Hospital for a femoral fracture could expect to spend an average of 78 days, or over two months, healing in hospital (Table C.13). The majority of the working poor depending upon daily wages for survival and entering hospital for any period of time may not have been feasible. This economy of makeshifts (Hufton, 1974) would not support a lengthy convalescence. Having the male head of household fall ill could be devastating to a family's financial situation. There are other clues in the archival records of difficult domestic decisions: many women were admitted into hospital with a child, possibly because it was safer or less expensive than seeking accommodation for them elsewhere.

The length of stay results reveal that the average patient admitted to a voluntary hospital in London due to fracture spent long enough (i.e., four to six weeks) in hospital for significant healing to take place, based upon contemporary clinical estimations (Eiff & Hatch, 2011). These results add credence to the historical literature reconsidering the role of the hospital in eighteenth-century society and counter the position that hospitals could be summed up as "gateways to death" (Helleiner, 1957, p. 6) and institutions that "positively did harm" (McKeown & Brown, 1955, p. 125).

8.1.6 Are there individuals seeking multiple re-admissions to hospital in the admissions dataset?

Identifying injury recidivists in skeletal samples is a complex matter. It is usually only possible to identify individuals with multiple fractures accumulated throughout their lifetime. This skeletal sample included individuals with antemortem healed, healing, and perimortem fractures, allowing for the relative sequence of fracture events to be reconstructed in 14 individuals. Glencross (2011) outlines the benefits of employing a life course model to "[construct] personal and social identities from skeletal injuries" (p. 391) and notes that bioarchaeology in particular has the ability to examine "animate and fluid evidence of lived experiences across historical time" (pp. 392-393). The visibility of fractures in the skeleton throughout the life course and after death provides the means to reconstruct fracture sequence and achieve a more comprehensive understanding of an individual's injuries. Different age cohorts are at differential risk for various fractures (Jones, 1994) and the accumulation of fractures may provide information on an individual's variable and changing risk throughout their life (Glencross, 2003; Lovejoy & Heiple, 1981).

It was equally challenging to discern individuals who may have suffered repeat injuries in the hospital admission records. I identified 41 cases that may represent individuals who returned to the same hospital either for readmission for the same fracture or for another fractured element. Long hospital stays were not desirable for the working poor, who were dependent upon wage labour, thus it is possible that the cases of repeat admission (Table 6.6) represent individuals attempting to return to work and suffering a relapse. The majority of individuals who appear to have sought repeated admission to hospital were male (14/21 = 66.7%); it is possible these individuals obtained early admission because they had families to support.

8.1.7 What are the occupations of individuals admitted to hospital?

Occupations data were recorded in the admission register for the Royal London Hospital and provide some information concerning the connection between occupation and injury. This dataset echoes the general findings of this research; legs are the most frequently fractured element in each occupational category. Contemporary studies of occupational hygiene, such as Bernardino Ramazzini's *De Morbis Artificum Diatriba, The Diseases of Workers* (1700), make little or no mention of broken bones. The current research, therefore, makes a meaningful contribution to historical studies of occupational health and hygiene. Historical studies have expressed the general lack of safety considerations within industry during the early part of the Industrial Revolution and suggest that accidents were seen "as a part of the expected and 'normal' flow and structure of everyday social life" (Cooter & Luckin, 1997, p. 3). The working poor could, therefore, expect to require medical care for accidents during their lifetime, hospital care being one among many available options.

8.2. FUTURE RESEARCH DIRECTIONS

There are many potential avenues of future research to explore using this dataset as a foundation. Future research should investigate comparisons with other British hospitals (e.g., Risse, 1986), which would open up discussions of health care access at a broader geographic scale. Comparisons with the records of provincial physicians would help to determine if the activities of an urban labourer were comparably hazardous to those of his rural counterpart. Loudon (1985) investigated the medical ledger of Benjamin and William Pulsford, medical practitioners operating in Wells, Somerset, between 1757 and c. 1764. In the ledger for 1757, there are 18 fractures and dislocations recorded, out of a total of 334 entries (Loudon, 1985, p. 11). Listed reasons for the accidents and injuries category, which includes fractures, range from being kicked by horses, to falls, and fighting (Loudon, 1985). Pulsford also recorded the occupations of individuals who came to the family practice; thus, it is possible to compare the occupational categories of individuals seeking medical care for a variety of ailments in urban and rural environments. Comparisons of injury patterns between metropolitan London and the provincial areas of England will illuminate a wider variety of fracture experiences.

Hospital death records are a potentially rich source of data for future comparisons. St. Bartholomew's Hospital, for example, has detailed death records including individuals' sex, age, and cause of death. Quantifying these data, with particular focus on the deaths caused by fracture, would put the perimortem results obtained in the current study in a richer historical context.

A broader examination of accidents and injuries in the archival hospital records is possible through combining the admissions due to fracture with those individuals admitted to hospital for bruises and body elements noted as being dislocated, contused, lacerated, jammed, hurt, injured, or wounded. Other accidents, such as burns and scalds, also frequently appear in the admission records. Conditions causing swelling and bruising in the body, such as dropsy, anasarca, and ecchymosis were frequently admitted. Rheumatism and general inflammation are common reasons for admission, as is catarrh, or inflammation of the mucous membranes. Ruptures, fistulas, and strangulated hernias make frequent appearances, and it would be illuminating to investigate whether or not these conditions correlate with individuals undertaking physically taxing occupations. Paralysis and hemiplegia also appear, as do frequent cases of epilepsy and apoplexy. Ulcers and gangrenous limbs, boils and carbuncles, tumours, and cases of infectious erysipelas are all recorded. In addition, males frequently seek hospital admission due to the "retention of urine," suggesting that cases of venereal disease, bladder infections, or prostate hyperplasia may be present. Quantification and comparison of these datasets will provide a vibrant picture of the variety of conditions causing discomfort and pain to members of the working poor during the eighteenth century. Bioarchaeological studies of infectious disease would be aided by these tabulations, which would provide a useful comparative dataset of living individuals affected by certain conditions. Bony changes due to infectious disease represent chronic cases; infectious diseases often only cause bony changes in a small proportion of individuals affected (Roberts & Manchester, 2005).

This research highlights the benefits of incorporating multiple lines of evidence to investigate a historical question. The uniting of bioarchaeological data with historical and contemporary clinical datasets contributes to historical accounts of fractures and health care by placing the working poor at the centre of their own narrative. The datasets speak in concert to amplify the voices of the working poor, who will shake off their obscurity and muteness (Deyon, 1975) through continued research.

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APPENDIX A – True Prevalence Datasets for Antemortem Fractures

Table A.1 Location of male antemortem fractures displayed by skeletal collection, side, number, and segment affected

		Hospitals Skeletal Sample				Parish/Church Skeletal Sample			
Element	**Side**	**N affected**	**Segment**			**N affected**	**Segment**		
			P3	**M3**	**D3**		**P3**	**M3**	**D3**
Femur	L	-	-	-	-	2/222 (0.9)	2/222 (0.9)	-	-
	R	3/99 (2.0)	1/97 (1.0)	2/96 (2.1)	-	6/227 (2.6)	3/226 (1.3)	3/224 (1.3)	-
Tibia	L	4/91 (4.4)	2/88 (2.3)	-	3/87(3.4)	3/199 (1.5)	-	-	3/197 (1.5)
	R	-	-	-	-	7/195 (3.6)	3/189 (1.6)	-	4/193 (2.1)
Fibula	L	4/84 (4.8)	2/78 (2.6)	-	2/76(2.6)	8/191 (4.2)	-	2/189 (1.1)	6/189 (3.2)
	R	7/80 (8.8)	1/77 (1.3)	1/80 (1.3)	5/77(6.5)	7/191 (3.7)	3/185 (1.6)	-	4/187 (2.1)
Humerus	L	1/100 (1.0)	-	-	1/100(1.0)	3/227 (1.3)	2/220 (0.9)	-	1/227 (0.4)
	R	-	-	-	-	4/231 (1.7)	-	2/229 (0.9)	2/230 (0.9)
Radius	L	1/94 (1.1)	-	-	1/92(1.1)	5/217 (2.3)	-	1/216 (0.5)	4/213 (1.9)
	R	2/96 (2.1)	-	-	2/92(2.2)	4/223 (1.8)	-	-	4/218 (1.8)
Ulna	L	-	-	-	-	2/226 (0.9)	-	-	2/216 (0.9)
	R	1/93 (1.1)	-	-	1/91(1.1)	1/230 (0.4)	-	-	1/224 (0.5)
Clavicle	L	-	-	-	-	2/225 (0.9)	-	-	2/223 (0.9)
	R	2/92 (2.2)	-	-	2/84(2.4)	2/228 (0.9)	-	-	2/222 (0.9)
Patella	L	2/67 (3.0)	-	-	-	4/144 (2.8)	-	-	-
	R	-	-	-	-	1/145 (0.7)	-	-	-
Ilium	L	1/100 (1.0)	-	-	-	1/231 (0.4)	-	-	-
	R	1/99 (1.0)	-	-	-	2/237 (0.8)	-	-	-
Sternum	U	-	-	-	-	3/151 (2.0)	1/145 (0.7)	2/148 (1.4)	-

Values in parentheses are percentages. L = left; R = right; U = unsided/single element.

There was one left tibia (RLP05 208) with two antemortem fractures, one hairline fracture to the posterior aspect of the lateral condyle and a hairline fracture to the posterior aspect of the distal interarticular surface. Table A.1 shows that the most frequently fractured elements were the left and right fibulae. Fisher's exact test was conducted on these data and there were no significant differences found between the hospitals and parish samples for any element. Further, there were no significant differences when comparing sided elements.

Table A.2 Location of female antemortem fractures displayed by skeletal collection, side, number, and segment affected

		Hospitals Skeletal Sample				Parish/Church Skeletal Sample			
Element	**Side**	**N affected**	**Segment**			**N affected**	**Segment**		
			P3	**M3**	**D3**		**P3**	**M3**	**D3**
Femur	L	1/50 (2.0)	1/50(2.0)	-	-	-	-	-	-
	R	-	-	-	-	-	-	-	-
Tibia	L	-	-	-	-	2/210 (1.0)	-	-	2/205 (1.0)
	R	-	-	-	-	2/209 (1.0)	1/203(0.5)	-	2/205 (1.0)
Fibula	L	-	-	-	-	2/198 (1.0)	-	-	2/191 (1.0)
	R	-	-	-	-	2/204 (1.0)	1/192 (0.5)	-	1/196 (0.5)
Humerus	L	1/48 (2.1)	-	-	1/48 (2.1)	1/237 (0.4)	-	-	1/237 (0.4)
	R	-	-	-	-	-	-	-	-
Radius	L	-	-	-	-	8/236 (3.4)	-	-	8/230 (3.5)
	R	2/49 (4.1)	-	1/49(2.0)	2/45 (4.4)	8/223 (3.6)	1/217 (0.5)	-	7/216 (3.2)
Ulna	L	2/49 (4.1)	1/46(2.2)	-	1/45 (2.2)	2/228 (0.9)	1/227 (0.4)	-	1/217 (0.5)
	R	1/47 (2.1)	-	1/42 (2.4)	-	1/223 (0.4)	1/222 (0.5)	-	-
Clavicle	L	-	-	-	-	-	-	-	-
	R	-	-	-	-	1/223 (0.4)	-	1/223(0.4)	-
Patella	L	-	-	-	-	1/146 (0.7)	-	-	-
	R	-	-	-	-	2/155 (1.3)	-	-	-
Ilium	L	-	-	-	-	-	-	-	-
	R	-	-	-	-	-	-	-	-
Sternum	L	-	-	-	-	-	-	-	-
	R	-	-	-	-	-	-	-	-

Values in parentheses are percentages. L = left; R = right.

There was one right tibia (PAY05 387) with two antemortem fractures: one hairline fracture to the posterior rim of the distal articular surface and a compression fracture to the posterior aspect of the medial plateau. One right radius (RLP05 247) had two antemortem fractures to the distal end: one hairline fracture on the distal articular surface and a Smith's fracture to the distal shaft. Table A.2 shows that the most frequently fractured elements were the right and left radii. Fisher's exact tests were employed and there were no significant differences found for any element between the hospitals and parish samples. There were no significant differences found between sided elements.

Table A.3 Location of antemortem cranial fractures displayed by side and number affected

			Hospitals Sample	Parish/Church Sample
Sex	**Element**	**Side**	**N affected**	**N affected**
M	**Mandible**	L	-	1/230 (0.4)
	Maxilla	R	1/81 (1.2)	-
	Nasal	L	6/43 (14.0)	21/162 (13.0)
		R	9/42 (21.4)	17/160 (10.6)
	Zygomatic	L	-	1/209 (0.5)
		R	-	1/202 (0.5)
F	**Nasal**	L	-	2/144 (1.4)

Values in parentheses are percentages. L = left; R = right.

Table A.3 shows that the most frequently fractured cranial elements in the males in both the hospital and parish/church skeletal samples were the left and right nasal bones. The only fractured cranial elements in the female sample were two left nasal bones from two individuals from the parish/church sample. There were no significant differences found for any skeletal element between the hospitals and parish samples using Fisher's exact test. There were no significant differences when comparing paired elements.

Table A.4 Location of scapular fractures in hospital cemeteries displayed by sex, side, and aspect affected

Sex	**Side**	**N affected**	**Glenoid fossa**	**Coracoid**	**Acromion/neck**	**Infraspinous portion**
M	L	1/96 (1.0)	**-**	**-**	1/80 (1.3)	-

Values in parentheses are percentages. L = left.

Table A.5 Location of scapular fractures in parish/church cemeteries displayed by sex, side, and aspect affected

Sex	**Side**	**N affected**	**Glenoid fossa**	**Coracoid**	**Acromion/neck**	**Infraspinous portion**
M	L	1/223 (0.4)	-	-	-	1/219 (0.5)
F	L	1/224 (0.4)	-	-	1/211 (0.5)	-

Values in parentheses are percentages. L = left.

Tables A.4 and A.5 show that there were a total of three scapular fractures in the total skeletal sample, one in a male from the hospital sample and one female and one male from the parish/church skeletal sample. The neck of the acromion was the most commonly fractured aspect of the scapula. The Fisher's exact test was performed on the data in Tables A.4 and A.5 and no significant differences were found between the hospitals and church samples or between any paired elements.

Table A.6 Antemortem fractures to the hand bones displayed by cemetery group, sex, element, and side

		Males		Females	
		Hospitals Sample	**Parish/church Sample**	**Hospitals Sample**	**Parish/church Sample**
Element	**Side**	**N affected**	**N affected**	**N affected**	**N affected**
Metacarpal 1	L	3/72 (4.2)	5/167 (3.0)	-	1/170 (0.6)
	R	5/79 (6.3)	13/178 (7.3)	-	2/182 (1.1)
Metacarpal 2	L	-	1/181 (0.6)	-	1/197 (0.5)
	R	-	2/188 (1.1)	-	-
Metacarpal 3	L	1/82 (1.2)	2/188 (1.1)	-	1/194 (0.5)
	R	1/82 (1.2)	3/187 (1.6)	-	-
Metacarpal 4	L	1/76 (1.3)	-	-	1/182 (0.5)
	R	1/76 (1.3)	-	-	-
Metacarpal 5	L	2/75 (2.7)	1/166 (0.6)	-	1/167 (0.6)
	R	4/77 (5.2)	3/177 (1.7)	-	2/176 (1.1)
Scaphoid	L	1/66 (1.5)	-	-	-
Trapezium	R	1/53 (1.9)	2/118 (1.7)	-	-
Hamate	L	-	-	-	2/116 (1.7)
Proximal Manual Phalanx	L	1/165 (0.6)	1/677 (0.1)	-	4/598 (0.7)
	R	-	5/657 (0.8)	-	-
	U	4/420 (1.0)	4/309 (1.3)	-	1/425 (0.2)
Intermediate Manual Phalanx	R	1/108 (0.9)	1/392 (0.3)	-	-
	U	2/267 (0.7)	1/241 (0.4)	-	-
Distal Manual Phalanx	L	1/66 (1.5)	-	-	1/154 (0.6)
	R	-	-	1/43 (2.3)	1/156 (0.6)

Values in parentheses are percentages. L = left; R = right; U = unsided.

Table A.6 shows that the most fractured elements were the right first metacarpal in males from the parish/church skeletal sample, the right fifth metacarpal in males from the hospital skeletal sample, and proximal manual phalanges in male individuals from the parish/church skeletal sample. There were no significant differences found between the hospitals and parish samples for any element or between any paired elements.

Table A.7 Antemortem fractures to the foot bones displayed by cemetery group, sex, element, and side

		Males		Females	
		Hospitals Sample	Parish/church Sample	Hospitals Sample	Parish/church Sample
Element	**Side**	**N affected**	**N affected**	**N affected**	**N affected**
Metatarsal 1	L	2/71 (2.8)	1/169 (0.6)	-	-
	R	-	1/168 (0.6)	-	-
Metatarsal 2	L	-	4/164 (2.4)	-	-
	R	-	1/167 (0.6)	-	-
Metatarsal 3	L	-	3/164 (1.8)	-	-
	R	1/66 (1.5)	-	-	-
Metatarsal 4	L	-	1/159 (0.6)	-	-
	R	1/63 (1.6)	1/161 (0.6)	-	-
Metatarsal 5	L	-	4/157 (2.5)	-	-
	R	-	2/164 (1.2)	-	-
Calcaneus	L	1/69 (1.4)	4/169 (2.4)	1/31 (3.2)	-
	R	1/77 (1.3)	1/176 (0.6)	1/36 (2.8)	-
Talus	L	1/72 (1.4)	4/165 (2.4)	-	-
Cuboid	R	-	1/150 (0.7)	-	-
Medial Cuneiform	L	-	1/142 (0.7)	-	-
Navicular	L	-	-	-	2/154 (1.3)
	R	-	-	-	3/145 (2.1)
Proximal Pedal Phalanx	L	-	1/476 (0.2)	-	-
	U	2/283 (0.7)	-	-	-
Distal Pedal Phalanx	L	-	5/139 (3.6)	-	-
	R	-	3/162 (2.5)	-	-
	U	1/40 (2.5)	1/51 (2.0)	-	-

Values in parentheses are percentages. L = left; R = right; U = unsided.

Table A.7 shows that more fractured foot bones were found in the parish/church skeletal sample. The most frequently fractured elements were the distal pedal phalanges and calcanei in the males. There were very few fractures of the feet found in the female skeletal sample, though navicular fractures were only found in the female parish/church skeletal sample. The Fisher's exact test revealed that despite there being no significant difference between the hospitals and parish skeletal samples for any of the elements of the foot, there was a significantly higher number of fractured left tali (n = 5) than right tali (n = 0) (Fisher's exact statistic: 0.026432, $p < 0.05$) in the male skeletal sample. In addition, there was a statistically significant higher prevalence of navicular fractures in females than males.

Table A.8 Location of antemortem vertebral fractures by cemetery group, sex and aspect of vertebra

		Hospitals Sample			Parish/church Sample		
Sex	**Vertebral Type**	**N affected**	**Vertebral Aspect**		**N affected**	**Vertebral Aspect**	
			Body	**Neural Arch**		**Body**	**Neural Arch**
Male	**Cervical**	-	-	-	2/1458 (0.1)	-	2/1435 (0.1)
	Thoracic	8/1163 (0.7)	5/1015 (0.5)	3/986 (0.3)	16/2678 (0.6)	14/2617(0.5)	2/2601 (0.1)
	Lumbar	-	-	-	1/1127 (0.1)	1/1101 (0.1)	-
	Sacrum Segment 1	-	-	-	1/218 (0.5)	1/214 (0.5)	-
Female	**Cervical**	-	-	-	2/1457 (0.1)	2/1450 (0.1)	-
	Thoracic	-	-	-	7/2682 (0.3)	5/2642 (0.2)	2/2583 (0.1)
	Lumbar	3/223 (1.3)	3/202 (1.5)	-	-	-	-

Values in parentheses are percentages.

Table A.8 shows that the most fractured element in both males and females was the thoracic vertebra. The vertebral body was more commonly fractured than elements of the neural arch, a result that was significant ($p < 0.05$) in the male parish/church skeletal sample. More vertebral fractures were discovered in the parish/church sample than the hospital skeletal sample, though the difference was not statistically significant. In the male sample there were no significant differences between the hospitals and parish samples for any vertebrae. There were, however, significantly more fractures of the thoracic vertebrae than cervical, lumbar, or sacral (χ^2 15.76965, $p < 0.05$). In the female sample, there were a significantly higher number of lumbar fractures in the hospital sample (Fisher's exact statistic: 0.00434, $p < 0.05$).

Table A.9 Rib fractures by cemetery group, sex, and side

		Hospital Sample	**Parish/church Sample**
Sex	**Side**	**N affected**	**N affected**
Male	L	19/960 (2.0)	90/2221 (4.1)
	R	26/957 (2.7)	111/2332 (4.8)
	U	17/1924 (0.9)	76/4560 (1.7)
Female	L	9/417 (2.2)	38/2289 (1.7)
	R	5/452 (1.1)	38/2308 (1.6)
	U	2/879 (0.2)	35/4611 (0.8)

Values in parentheses are percentages. L = left; R = right; U = unsided.

Table A.9 shows that the most fractured element was the right rib in males from the parish/church skeletal sample. In the male skeletal sample there was a significantly higher proportion of rib fractures in the parish sample for the left ($\chi^2 = 8.7048$, $p < 0.05$), right ($\chi^2 = 7.095$, $p < 0.05$), and unsided ribs ($\chi^2 = 5.8693$, $p < 0.05$). There was no significant difference between the left and right-sided ribs within groups. There was no significant difference in the female sample between the hospitals and parish samples or between the sided elements.

Table A.10 – Chi square comparison of males and females with antemortem cranial fractures by element

	Fractured	Not fractured	Total
Male	57	1072	1129
Female	2	142	144
Total	59	1214	1273

Chi-square statistic: 3.8702. P value is 0.04915. Significant at $p < 0.05$.

Table A.11 – Chi square comparison of males and females with antemortem torso fractures by element

	Fractured	Not fractured	Total
Male	375	20041	20416
Female	139	15381	15520
Total	514	35422	35936

Chi-square statistic: 55.3965. P value is 0. Significant at $p < 0.05$.

Table A.12 – Chi square comparison of male and females with antemortem arm fractures by element

	Fractured	Not fractured	Total
Male	32	2569	2601
Female	28	1759	1787
Total	60	4328	4388

Chi-square statistic: 0.8897. P value is 0.34555. Not significant at $p < 0.05$.

Table A.13 – Chi square comparison of males and females with antemortem hand fractures by element

	Fractured	Not fractured	Total
Male	73	5517	5590
Female	19	2741	2760
Total	92	8258	8350

Chi square statistic: 6.4657. P value: 0.010998. Significant at $p < 0.05$.

Table A.14 – Chi square comparison of males and females with antemortem leg fractures by element

	Fractured	**Not fractured**	**Total**
Male	57	1878	1935
Female	12	1160	1172
Total	69	3038	3107

Chi square statistic: 12.4151. P value: 0.000426. Significant at $p < 0.05$.

Table A.15 – Chi square comparison of males and females with antemortem foot fractures by element

	Fractured	**Not fractured**	**Total**
Male	49	3795	3844
Female	7	359	366
Total	56	4154	4210

Chi square statistic: 12.4151. P value: 0.000425. Not significant at $p < 0.05$.

APPENDIX B – SUMMARIZED SKELETAL FRACTURE INFORMATION

Table B.1 Summary of fractured elements in skeletal dataset

Museum of London Code	Sex	Age Group	Fractured Elements
PAY05 153	M	10	CV 7 (spinous process)
PAY05 213	M	8	TV 6 (body), TV 7 (body), TV 8 (body), TV 9 (body), TV 10 (body), TV 11 (body), TV 12 (body)
PAY05 773	M	9	R ulna (styloid process), R fibula (proximal end)
PAY05 816	M	8	4 L ribs (2 x sternal end, 1 x angle, 1 x neck), 5 R ribs (1 x angle and sternal shaft, 1 x sternal shaft, 2 x sternal end, 1 x anterior shaft), 1 U rib (shaft), TV 9 (body), sternum (body), L fibula (distal end), L MC1 (base), L MC3 (shaft), R humerus (medial epicondyle), L MT1 (distal end), L MT2 (shaft), R calcaneus (cuboid articular surface), L nasal (body), R nasal (body), L zygomatic arch
PAY05 164	M	8	L nasal (body)
PAY05 442	M	10	2 L ribs (1 x shaft), 2 U ribs (2 x shaft)
PAY05 113	M	7	L MC5 (distal end)
PAY05 527	M	9	L rib (lateral shaft), 2 R ribs (1 x angle, 1 x sternal shaft), 2 U ribs (2 x shaft)
PAY05 746	M	10	TV 6 (body)
PAY05 894	M	10	R clavicle (lateral shaft)
PAY05 264	M	10	L radius (distal shaft)
PAY05 797	M	9	1 U rib (lateral shaft)
PAY05 402	M	10	1 R rib (angle)

PAY05 250	M	9	R MC1 (distal end), 1 U PMP (proximal articular surface), 1 L rib (sternal shaft), 2 R ribs (2 x lateral shaft), 1 U rib (sternal shaft)
PAY05 659	M	8	TV 7 (body), TV 8 (body), TV 9 (body)
PAY05 115	M	9	L MC3 (styloid process), R MC3 (styloid process)
PAY05 141	M	7	L nasal (body)
PAY05 203	M	9	L talus (superior surface), sacrum (centrum of S1)
PAY05 209	M	10	R MC1 (proximal end), 1 L rib (lateral shaft), 1 U rib (shaft)
PAY05 460	M	8	L fibula (midshaft)
PAY05 832	M	10	R fibula (distal end), L radius (distal shaft), L ulna (styloid process), LV 1 (body), 1 R rib (shaft)
PAY05 846	M	10	R MC1 (proximal end)
PAY05 215	M	7	L radius (distal articular surface)
PAY05 313	M	8	R os coxa (lunate surface of superior acetabulum), 1 U rib (shaft)
PAY05 336	M	10	R nasal (body)
PAY05 447	M	10	R MC1 (proximal end), R MT5 (distal shaft)
PAY05 680	M	10	1 R rib (anterior to rib head)
PAY05 694	M	9	L ulna (distal end), R MC1 (proximal shaft), 1 U rib (angle)
PAY05 627	M	9	4 L ribs (3 x angle, 1 x sternal shaft), 2 R ribs (1 x sternal shaft, 1 x shaft), R zygomatic arch
BBP07 8	M	9	U PMP (proximal end)
BBP07 44	M	10	L humerus (lateral condyle), R humerus (medial epicondyle), U PMP (proximal end)
BBP07 90	M	9	CV 7 (spinous process), 1 U rib (shaft)
BBP07 68	M	10	1 U rib (shaft), L MC1 (proximal end), R MC1 (proximal end)
BBP07 161	M	9	L MC1 (proximal end)
REW92 1	M	9	L humerus (head), 4 R ribs (4 x anterior to angle)
REW92 11	M	9	TV 11 (body), 1 R rib (angle), R MC1 (shaft)
REW92 114	M	10	1 U rib (shaft)
REW92 119	M	9	R nasal (base), 2 L ribs (2 x angle)
REW92 161	M	11	R femur (neck)
REW92 167	M	8	5 L ribs (3 x shaft, 2 x sternal end), 3 R ribs (2 x shaft, 1 x anterior to angle)
REW92 171	M	9	L nasal (body), 1 L rib (sternal end), 1 R rib (anterior to angle), 9 U ribs (9 x shaft)
FAO90 1200	M	10	R femur (midshaft)

FAO90 1500	M	10	2 R ribs (lateral shaft), R femur (neck), L patella (lateral articular surface)
FAO90 1052	M	10	L MT5 (proximal articular surface with MT4)
FAO90 1126	M	9	L MT5 (proximal end)
FAO90 1141	M	9	6 U ribs (5 x shaft, 1 x sternal shaft)
FAO90 1155	M	9	L radius (midshaft)
FAO90 1209	M	9	L rib (lateral shaft)
FAO90 1251	M	10	R DPP 1 (proximal articular surface)
FAO90 1288	M	10	L DPP 1 (proximal articular surface) L PPP (proximal articular surface)
FAO90 1290	M	8	R radius (distal articular surface), L calcaneus (articulation for cuboid), L medial cuneiform (articular surface for MT 1)
FAO90 1312	M	9	L DPP 1 (proximal articular surface), L nasal (body), R nasal (body)
FAO90 1320	M	11	L nasal (maxillary-nasal border)
FAO90 1330	M	11	2 L ribs (1 x angle, 1 x anterior to head), 1 R rib (anterior to head), 9 U ribs (8 x lateral shaft, 1 x anterior to head)
FAO90 1338	M	9	R MC5 (midshaft0
FAO90 1396	M	11	2 L ribs (1 x angle, 1 x anterior to angle), 3 R ribs (2 x angle, 1 x anterior to angle), 1 U rib (shaft)
FAO90 1415	M	8	R MT4 (proximal articular surface), sternum
FAO90 1503	M	10	L clavicle (lateral end), L nasal (body), R nasal (body)
FAO90 1515	M	10	TV 3 (spinous process), 3 L ribs (3 x head)
FAO90 1521	M	10	L fibula (distal shaft), R fibula (proximal shaft), R femur (midshaft), R MC1 (distal end), R MC2 (distal end), L rib (sternal shaft)
FAO90 1525	M	10	L patella (mesial portion of articular surface)
FAO90 1543	M	10	L nasal (body), R nasal (body), 3 L ribs (2 x central shaft, 1 x angle), 2 R ribs (2 x central shaft)
FAO90 1546	M	9	R tibia (proximal lateral articular surface), R fibula (proximal shaft), 5 R ribs (5 x shaft), R MC3 (styloid process), R MC5 (midshaft), U PMP (proximal articular surface), blunt force trauma to occipital
FAO90 1549	M	10	U DPP 1 (proximal articular surface)
FAO90 1558	M	9	L nasal (body), R nasal (body), 1 L rib (central shaft), 1 R rib (angle), 1 U rib (shaft)
FAO90 1563	M	9	L os coxa (superior rim of acetabulum), R PMP (proximal articular surface), 1 R rib (angle)
FAO90 1606	M	10	R tibia (proximal lateral articular surface), L talus (calcaneal articular surface), L DPP 1

			(proximal articular surface), R DPP 1 (proximal articular surface), R MT1 (proximal articular surface)
FAO90 1613			Blunt force trauma to frontal bone
FAO90 1621	M	10	3 L ribs (3 x lateral shaft)
FAO90 1635	M	10	L MT2 (midshaft), R MC1 (proximal end), R trapezium (MC1 articular surface), 1 L rib (sternal shaft), 5 R ribs (3 x lateral shaft, 2 x sternal shaft),
FAO90 1673	M	9	R MC1 (proximal end)
FAO90 1689	M	10	3 U ribs (3 x shaft)
FAO90 1695	M	10	L MT5 (articular surface for MT4), 1 L rib (lateral shaft)
FAO90 1719	M	10	TV 3 (R inferior articular facet)
FAO90 1739	M	10	L nasal (body), R nasal (body), L rib (sternal end)
FAO90 1745	M	10	L nasal (maxillary-nasal border), L rib (shaft), R rib (lateral shaft)
FAO90 1763	M	10	L nasal (body), R nasal (body), R MC2 (proximal shaft), R MC3 (proximal shaft)
FAO90 1797	M	10	L nasal (body), R nasal (body), L fibula (distal shaft), 2 L ribs (2 x central shaft)
FAO90 1825	M	9	L patella (body), L MT2 (proximal articular surface), L MT3 (proximal articular surface), R MT5 (proximal articular surface for MT4), L talus (calcaneal articular surface)
FAO90 1827	M	10	L fibula (distal intraarticular surface), R fibula (distal intraarticular surface), R tibia (distal intraarticular surface), multiple blunt force trauma to frontal, R parietal, and occipital
FAO90 1829	M	10	2 R ribs (2 x lateral shaft)
FAO90 1853	M	10	TV 8 (body), 3 L ribs (2 x angle, 1 x shaft), 3 R ribs (shaft)
FAO90 1855	M	11	1 U rib (shaft)
FAO90 1862	M	10	L MT3 (distal shaft), L MT4 (distal shaft), R MT2 (proximal articular surface), L nasal (body), 7 L ribs (7 x anterior to head), 8 R ribs (8 x shaft)
FAO90 1868	M	10	2 L ribs (2 x anterior to head), 2 R ribs (2 x anterior to head), 2 U ribs (2 x shaft)
FAO90 1870	M	10	1 L rib (angle), 3 R ribs (2 x anterior to angle, 1 x anterior to head), 1 U rib (shaft)
FAO90 1881	M	9	R femur (neck), R radius (distal end), 3 U ribs (3 x shaft)
FAO90 1885	M	9	L calcaneus (anterior portion below talar articular surface), L MT5 (proximal articular surface)
FAO90 1901	M	9	1 U rib (shaft)
FAO90 1905	M	10	L nasal (body), R nasal (body), 1 L rib (sternal shaft), 1 R rib (lateral shaft)
FAO90 1917	M	10	R PMP (proximal articular surface)

FAO90 1925	M	8	R trapezium (articular surface for MC1)
FAO90 1930	M	10	L femur (proximal shaft)
FAO90 1938	M	7	R femur (midshaft), blunt force trauma to frontal bone
FAO90 1942	M	10	R MC1 (distal end), 1 U rib (shaft)
FAO90 1957	M	9	1 L rib (sternal shaft), L MC1 (proximal end), R DPP 1 (distal end)
FAO90 1959	M	10	L calcaneus (posterior articular facet for talus)
FAO90 1991	M	10	L patella (superior border of lateral facet), R patella (lateral aspect of lateral facet), L talus (anterior articular facet for calcaneus), L MT3 (midshaft), 2 L ribs (2 x shaft)
FAO90 2011	M	10	1 L rib (angle), 1 R rib (anterior to head)
FAO90 2015	M	9	L nasal (body)
FAO90 2023	M	10	L tibia (talocrural joint & distal end), R tibia (posterior border of mesial plateau surface), R humerus (midshaft), L clavicle (lateral end), 2 R ribs (2 x lateral shaft), 1 U rib (shaft)
FAO90 2029	M	10	L femur (neck), 1 U rib (shaft)
FAO90 2053	M	10	2 L ribs (2 x anterior to angle), 6 R ribs (1 x lateral shaft, 5 x anterior to head), 7 U ribs (7 x shaft)
FAO90 2058	M	8	R IMP (proximal articular surface)
FAO90 2059	M	11	R radius (distal articular surface)
FAO90 2061	M	9	R nasal (body)
FAO90 2075	M	10	R PMP (midshaft), sternum
FAO90 2077	M	10	1 L rib (lateral shaft), 2 U ribs (2 x shaft)
FAO90 2109	M	10	L DPP 1 (proximal articular surface), R MC1 (proximal end), U IMP (proximal articular surface), 1 R rib (lateral shaft), 1 U rib (shaft)
FAO90 2126	M	10	R radius (distal end), R cuboid (articular surface for MT4 and MT5), 4 L ribs (1 x anterior to angle, 3 x lateral shaft), 1 R rib (anterior to angle), 1 U rib (shaft)
FAO90 2138	M	10	2 U ribs (2 x shaft)
FAO90 2140	M	8	R tibia (distal intraarticular surface), R fibula (distal end), R clavicle (lateral end)
FAO90 2150	M	11	Sharp force trauma to occipital
FAO90 2152	M	10	L tibia (talocrural joint), L fibula (distal end), R tibia (talocrural joint), R fibula (distal end), L radius (distal end)
FAO90 2164	M	9	R os coxa (iliac blade), L nasal (body), R nasal (body), mandible (L mandibular condyle)
FAO90 2165	M	8	2 L ribs (2 x lateral shaft), 1 R rib (lateral shaft)

FAO90 2189	M	10	R PMP 1 (proximal articular surface), 5 R ribs (2 x angle, 3 x shaft)
FAO90 2191	M	10	L fibula (midshaft), L humerus (neck), L MT2 (midshaft), R MC1 (midshaft), R PMP 1 (proximal articular surface), L nasal (body), R nasal (body), 3 L ribs (1 x lateral shaft, 1 x anterior to angle, 1 x anterior to head), 1 R rib (lateral shaft), 5 U ribs (5 x shaft), blunt force trauma on frontal bone above glabella, sharp force trauma above R orbit
FAO90 2193	M	10	L scapula (blade), 1 U rib (sternal shaft)
FAO90 2195	M	10	R MC5 (proximal end), L nasal (body), R nasal (body), nasal septum, 4 L ribs (3 x sternal shaft, 1 x lateral shaft), 6 R ribs (1 x anterior to angle, 4 x lateral shaft, 1 x sternal shaft)
FAO90 2205	M	10	R tibia (lateral distal shaft), R humerus (midshaft), L DPP 1 (proximal articular surface)
FAO90 2209	M	9	L tibia (posterior aspect of distal articular surface)
FAO90 2243	M	9	3 R ribs (1 x lateral shaft, 2 x angle)
FAO90 2253	M	10	L nasal (body), R nasal (body)
FAO90 2263	M	9	L nasal (body), R nasal (body)
FAO90 2269	M	10	L PMP 1 (proximal articular surface), L MC2 (proximal articular surface), 4 L ribs (4 x angle), 1 R rib (1 x anterior to head)
FAO90 2296	M	10	1 R rib (shaft), 2 U ribs (2 x shaft)
FAO90 2302	M	8	3 L ribs (2 x anterior to angle, 1 x lateral shaft), 8 R ribs (7 x angle, 1 x lateral shaft)
FAO90 2304	M	10	L MC1 (proximal end)
FAO90 2342	M	10	1 R rib (head)
FAO90 2366	M	9	L calcaneus (mesial articular surface for talus), 3 L ribs (3 x lateral shaft), 6 R ribs (4 x angle, 1 x anterior to angle, 1 x lateral shaft)
RLP05 105	M	8	L radius (distal end)
RLP05 109	M	8	L tibia (posterior aspect of lateral condyle)
RLP05 119	M	10	blunt force trauma to frontal bone between L orbit and glabella
RLP05 124	M	10	R femur (midshaft), 2 R ribs (2 x lateral shaft), R MT4 (proximal shaft)
RLP05 133	M	9	L MC5 (midshaft), R calcaneus (post-talar intraarticular surface), L nasal (body), R nasal (body)
RLP05 137	M	9	R fibula (proximal articular surface), 2 R ribs (2 x sternal shaft)
RLP05 138	M	9	L nasal (body), R nasal (body), R fibula (distal articular surface), R os coxa (iliac blade), 3 R ribs (3 x angle)
RLP05 152	M	11	2 R ribs (1 x lateral shaft, 1 x angle)

RLP05 161	M	8	L MC1 (proximal end), R IMP (proximal articular surface)
RLP05 194	M	11	R fibula (distal shaft), U PPP (midshaft), R nasal (body)
RLP05 199	M	9	1 R rib (lateral shaft)
RLP05 208	M	9	L tibia (posterior aspect of lateral condyle and posterior aspect of distal intraarticular surface), L fibula (distal articular surface), L patella (posterior aspect of lateral facet), R MC1 (proximal end), R MC5 (proximal end), U IMP (proximal articular surface)
RLP05 239	M	8	R fibula (mid-distal shaft), R MC1 (proximal end), R MC3 (midshaft), L nasal (body), R nasal (body), 1 R rib (angle), R clavicle (midshaft)
RLP05 242	M	9	TV 3 (body), TV 4 (body), TV 5 (body), TV 6 (body), 2 L ribs (1 x lateral shaft, 1 x anterior to angle), 1 R rib (anterior to head), 1 U rib (shaft)
RLP05 249	M	10	L talus (lateral tubercle)
RLP05 289	M	7	TV 5 (anterior portion of superior body surface)
RLP05 305	M	8	R clavicle (lateral end)
RLP05 307	M	9	R nasal (body), 1 L rib (angle)
RLP05 340	M	9	U PPP (distal end), L nasal (body)
RLP05 349	M	9	TV 4 (spinous process), 1 R rib (angle)
RLP05 356	M	11	U PMP (proximal articular surface)
RLP05 358	M	9	U PMP 1 (proximal articular surface)
RLP05 368	M	11	L fibula (proximal shaft)
RLP05 369	M	9	R femur (midshaft), L fibula (distal shaft), R MT3 (articular facet for MT4), R nasal (body)
RLP05 398	M	11	R tibia (lateral condyle surface), R radius (head), L os coxa (intraarticular fissure in acetabulum)
RLP05 408	M	10	R MC5 (midshaft), R MC1 (proximal end)
RLP05 414	M	8	L patella (inferior portion), R MC5 (head), U PMP (proximal articular surface)
RLP05 421	M	9	L tibia (distal shaft), L fibula (proximal shaft), R fibula (distal articular surface), U PMP (distal shaft), R radius (tip of styloid process), L scapula (neck/lateral border)
RLP05 423	M	9	R fibula (lateral malleolus), blunt force trauma to L frontal
RLP05 486	M	9	2 U ribs (2 x shaft)
RLP05 492	M	10	L MC1 (proximal end), 2 R ribs (1 x angle, 1 x lateral shaft)
RLP05 497	M	7	1 U rib (shaft)
RLP05 521	M	8	U IMP (proximal articular surface), L scaphoid (lunate articular surface), 2 L ribs (1 x lateral

			shaft, 1 x angle), 3 U ribs (3 x shaft)
RLP05 551	M	10	U DPP 1 (proximal articular surface), TV 6 (spinous process), 5 R ribs (5 x lateral shaft)
RLP05 563	M	8	R fibula (distal shaft), 2 L ribs (1 x lateral shaft, 1 x angle)
RLP05 572	M	9	TV 1 (spinous process), sharp force trauma to R parietal
RLP05 577	M	9	R nasal (body), 2 L ribs (2 x angle)
RLP05 588	M	9	L humerus (medial epicondyle), 1 R rib (sternal end), L MC1 (proximal articular surface), L MC3 (proximal articular surface), L MC4 (proximal articular surface), L MC5 (proximal articular surface)
RLP05 591	M	9	R femur (proximal shaft), R trapezium (articular surface for MC1)
RLP05 18201	M	11	1 L rib (angle and sternal shaft)
RLP05 19201	M	11	L nasal (body), R nasal (body), R maxilla (frontal process), 1 L rib (lateral shaft)
RLP05 22801	M	8	2 L ribs (2 x sternal shaft)
RLP05 27204	M	11	1 L rib (head), 1 R rib (head)
RLP05 181	M	9	1 L rib (lateral shaft)
RLP05 34803	M	11	L nasal (body), R nasal (body), 1 L rib (lateral shaft)
RLP05 11502	M	9	R MC5 (midshaft), 1 U rib (shaft)
RLP05 504	M	7	L calcaneus (superior process)
RLP05 222	M	10	R MC1 (proximal end), R MC4 (proximal end to articular surface for MC5), R radius (distal articular surface), R ulna (styloid process)
NLB91 2	M	10	2 R ribs (1 x angle, 1 x shaft)
NLB91 30	M	9	L MT1 (proximal end)
NLB91 45	M	11	2 U ribs (2 x shaft)
NLB91 48	M	9	R MC1 (mesial aspect of base), 3 L ribs (2 x angle, 1 x lateral shaft), 1 R rib (lateral shaft), 5 U ribs (5 x shaft)
NLB91 76	M	9	Blunt force trauma to L parietal
NLB91 109	M	8	L tibia (distal end at articular surface)
NLB91 141	M	10	L DMP 1 (proximal end)
NLB91 171	M	7	L PMP 1 (proximal end)
NLB91 180	M	10	L MT1 (proximal end)
NLB91 187	M	9	1 U rib (shaft)

NLB91 204	M	9	1 U rib (angle)
NLB91 216	M	10	1 U rib (shaft)
NLB91 218	M	7	Blunt force trauma to L parietal
PAY05 314	F	8	L radius (styloid process)
PAY05 775	F	9	4 L ribs (3 x anterior to angle, 1 x anterior shaft), 4 R ribs (4 x shaft)
PAY05 696	F	10	L radius (distal end), L ulna (styloid process)
PAY05 738	F	8	R navicular (inferior portion)
PAY05 317	F	9	TV 9 (antero-superior portion of body), 3 R ribs (3 x sternal shaft), 2 U ribs (2 x shaft)
PAY05 468	F	10	R MC5 (distal shaft)
PAY05 188	F	9	2 U ribs (2 x sternal shaft)
PAY05 151	F	10	R radius (distal end), L patella (articular surface), R patella (articular surface)
PAY05 243	F	11	L radius (distal end), L scapula (neck of acromion)
PAY05 426	F	10	1 R rib (anterior to angle)
PAY05 833	F	9	L navicular (articular surface)
PAY05 565	F	8	1 U rib (sternal shaft)
PAY05 382	F	9	TV (right lamina)
PAY05 395	F	9	L MC1 (proximal end), R MC1 (proximal end)
PAY05 137	F	7	R MC5 (distal end)
PAY05 387	F	10	R fibula (distal end), R tibia (posterior rim of distal articular surface and posterior aspect of medial plateau), 1 L rib (anterior to angle), 1 R rib (lateral shaft)
PAY05 826	F	10	1 L rib (lateral shaft)
PAY05 193	F	10	L tibia (distal end), L fibula (distal end), R radius (styloid process)
PAY05 171	F	10	L radius (distal end), R MC1 (distal end)
PAY05 778	F	9	R navicular (lateral rim)
REW92 32	F	9	3 L ribs (2 x angle, 1 x sternal end), 1 U rib (shaft)
REW92 52	F	10	TV 5 (body), TV 6 (body), 1 U rib (shaft)
REW92 91	F	9	U PMP (proximal end)
REW92 118	F	9	L DMP 1 (base), 1 L rib (angle), 1 R rib (anterior to angle)
REW92 157	F	10	R radius (distal shaft)
REW92 175	F	10	R radius (distal radial articular surface)

FAO90 1151	F	10	2 L ribs (2 x anterior to head), 1 U rib (shaft)
FAO90 1166	F	8	L hamate, 1 U rib (lateral shaft)
FAO90 1174	F	10	L hamate (articular surface for L MC5)
FAO90 1221	F	10	1 R rib (anterior to angle)
FAO90 1269	F	10	Blunt force trauma to L parietal
FAO90 1352	F	10	L navicular (superior and inferior surface), R navicular (inferior border)
FAO90 1369	F	10	1 R rib (lateral shaft)
FAO90 1417	F	10	1 L rib (angle), 1 R rib (lateral shaft)
FAO90 1509	F	9	1 L rib (lateral shaft)
FAO90 1547	F	10	L radius (distal end), 3 R ribs (3 x sternal shaft)
FAO90 1586	F	8	1 U rib (shaft)
FAO90 1610	F	10	TV 5 (body), TV 6 (body)
FAO90 1634	F	9	L tibia (talocrural joint), L fibula (distal end)
FAO90 1653	F	8	1 R rib (angle)
FAO90 1741	F	10	R radius (distal intraarticular surface)
FAO90 1753	F	10	1 R rib (angle), 3 U ribs (3 x shaft)
FAO90 1757	F	10	L radius (distal end)
FAO90 1781	F	10	1 L rib (lateral shaft)
FAO90 1787	F	8	L humerus (olecranon), L ulna (olecranon process)
FAO90 1795	F	10	R radius (distal end)
FAO90 1799	F	9	R patella (margin of mesial articular surface), 1 R rib (shaft), 1 U rib (shaft)
FAO90 1809	F	9	Sharp force trauma to R parietal
FAO90 1897	F	10	4 L ribs (1 x anterior to head, 1 x angle, 2 x shaft), 4 R ribs (1 x anterior to head, 1 x angle, 2 x shaft), 15 U ribs (15 x shaft)
FAO90 1913	F	10	L radius (distal end), 2 L ribs (2 x sternal shaft), 1 R rib (lateral shaft)
FAO90 1940	F	10	L MC2 (head), L MC3 (midshaft), L MC4 (distal shaft), L MC5 (distal shaft), 3 x L PMP (3 x proximal articular surface)
FAO90 1946	F	9	R fibula (proximal end), R radius (lateral border, articulation with scaphoid), 1 L rib (sternal shaft), 2 R ribs (2 x angle)
FAO90 1990	F	8	R DMP (proximal articular surface)

FAO90 2065	F	10	2 L ribs (2 x shaft)
FAO90 2073	F	10	TV 8 (left transverse process), 2 U ribs (2 x shaft)
FAO90 2105	F	10	1 L rib (anterior to head)
FAO90 2116	F	10	6 L ribs (6 x lateral shaft)
FAO90 2122	F	10	CV 3 (body), CV 4 (body), 1 U rib (shaft)
FAO90 2144	F	8	R tibia (medial malleolus), L PMP (proximal articular surface)
FAO90 2201	F	11	L nasal (body)
FAO90 2216	F	9	2 R ribs (anterior to head)
FAO90 2223	F	8	1 U rib (shaft)
FAO90 2308	F	9	R radius (head), R ulna (olecranon process)
FAO90 2332	F	9	1 U rib (shaft)
FAO90 2383	F	9	L nasal (body), L radius (distal end), 4 L ribs (1 x sternal end, 3 x lateral shaft), 6 R ribs (3 x sternal shaft, 3 x lateral shaft)
FAO90 2245.1	F	10	R clavicle (central shaft), 3 L ribs (2 x anterior to head, 1 x angle), 4 R ribs (4 x lateral shaft), 1 U rib (shaft)
RLP05 247	F	10	R tibia (posterior aspect of lateral plateau surface), R radius (distal articular surface)
RLP05 259	F	9	7 L ribs (1 x sternal shaft, 6 x lateral shaft), 1 R rib (angle)
RLP05 357	F	9	1 L rib (lateral shaft)
RLP05 386	F	9	LV 1 (anterior portion of superior vertebral body surface), LV 2 (anterior portion of superior vertebral body surface), 3 R ribs (1 x lateral shaft, 2 x neck)
RLP05 396	F	10	L calcaneus (anterior articular facet), L ulna (styloid process)
RLP05 411	F	8	1 U rib (shaft)
RLP05 420	F	7	LV 2 (body)
RLP05 595	F	10	L humerus (olecranon process) L ulna (olecranon)
RLP05 178	F	7	R calcaneus (anterosuperior margin of facet for talus)
NLB91 1	F	10	L femur (neck)
NLB91 23	F	10	1 R rib (shaft)
NLB91 31	F	9	R DMP (proximal end), 1 L rib (lateral shaft), 1 U rib (shaft)
NLB91 169	F	9	R radius (midshaft), R ulna (midshaft)

R = right; L = left; U = unsided; CV = cervical vertebra; TV = thoracic vertebra; LV = lumbar vertebra; MC = metacarpal; MT = metatarsal; PMP = proximal manual phalanx; DPP = distal pedal phalanx; PPP = proximal pedal phalanx; IMP = intermediate manual phalanx; DMP = distal manual phalanx. Age codes: 7 = Young Adult (18-25); 8 = Middle Adult 1 (26-35); 9 = Middle Adult 2 (36-45); 10 = Older Adult (46 +); 11 = Adult.

APPENDIX C – Archival Fracture Data

Table C.1 Distribution of individuals admitted to the London general hospitals, 1760 - 1840

Decade	Hospitals	Admitted for fractures	Admitted for other reasons	Admitted with no recorded reason	% of total admissions with reason	Total adults admitted
1760-1769	Middlesex	312	1139	3	99.8	1454
	Royal London	111	1199	1	99.9	1311
1770-1779	St. Thomas'	75	282	2103	14.5	2460
	Middlesex	482	2069	7	99.7	2558
1780-1789	St. Thomas'	507	1172	9693	14.8	11372
	Middlesex	545	1551	8	99.6	2104
1790-1799	St. Thomas'	482	1268	9793	15.2	11543
	Royal London	211	1605	80	95.8	1896
1800-1809	St. Thomas'	90	253	2112	14.0	2455
	Royal London	50	420	26	94.8	496
1810-1819	Guy's	770	1555	14748	13.6	17073
1820-1829	Guy's	1545	4170	20964	21.4	26679
1830-1839	Guy's	1449	5581	20721	25.3	27751
Total		6630	22364	80257	27.5	109150

Table C.1 displays the distribution of results available from 1760 – 1840 organized by decade. A total of 109,256 adult admissions are accounted for in the consulted hospital admission records. There is a clear division between the hospitals as to how many individuals were registered for admission with a reason listed. The Royal London Hospital and the Middlesex Hospital have a high percentage of reasons for admission listed, ranging from 94.8 to 99.9% complete. On the other hand, due to the clerks' registration practices, St. Thomas' and Guy's Hospitals have the reason for admission recorded for only a range of 13.6 to 25.3% of individuals. The quality of the data dictates how the data will be used to investigate the fracture experience of the working poor of London.

Table C.2 Total distribution of fractured individuals lost to observation

Decade	**Hospital**	**Fractured Individuals Lost to Observation**	**Fractured Individuals with Result Listed**
1760-1769	Middlesex	71	241
	Royal London	2	109
	Total	*73*	*350*
1770-1779	St. Thomas'	52	23
	Middlesex	82	400
	Total	*134*	*423*
1780-1789	St. Thomas'	165	342
	Middlesex	46	500
	Total	*211*	*842*
1790-1799	St. Thomas'	165	317
	Royal London	2	209
	Total	*167*	*526*
1800-1809	St. Thomas'	26	64
	Royal London	0	50
	Total	*26*	*114*
1810-1819	Guy's	106	666
1820-1829	Guy's	171	1373
1830-1839	Guy's	251	1198
Total		1139	5492

Table C.3 Fractured individuals lost to observation organized by sex and fractured element

Fractured Element	**Males**	**Females**
Compound Fractures		
Leg/Thigh/Foot	42	9
Arm/Hand/Finger	8	3
Unknown	5	0
Skull	3	0
Multiple Fractures	1	0
Simple Fractures		
Leg/Thigh	434	131
Arm/Hand	125	59
Rib/Sternum	102	12
Skull/Face	81	15
Shoulder Girdle	38	8
Knee/Patella	20	11
Spine/Back	13	0
Multiple Fractures	9	0
Unknown	4	2
Hip/Pelvis	3	1
Total	888	251

Table C.3 displays the location of the fractures of the individuals who entered the general hospitals with a fracture, but were lost to observation.

Tables C.4 and C.5 display the fracture distribution of individuals admitted to the Middlesex and Royal London hospitals organized by sex and divided into simple and compound fractures.

Table C.4 – Fracture distribution by individual in males from the Middlesex and Royal London hospitals

Body Area	1760-1769		1770-1779	1780-1789	1790-1799	1800-1809
Compound	*Middlesex*	*Royal London*	*Middlesex*	*Middlesex*	*Royal London*	*Royal London*
Thigh	1 (0.4)	0	0	1 (0.3)	1 (0.6)	0
Leg	5 (2.3)	6 (7.8)	17 (4.9)	24 (6.7)	9 (5.7)	2 (5.0)
Foot	0	0	0	0	0	0
Clavicle	0	0	1 (0.3)	0	0	0
Arm	5 (2.3)	2 (2.6)	0	1 (0.3)	2 (1.3)	0
Hand	0	0	0	0	0	0
Finger	1 (0.4)	0	0	0	0	0
Toe	0	0	0	1 (0.3)	1 (0.6)	0
Unknown	0	0	1 (0.3)	1 (0.3)	1 (0.6)	0
Multiple Fractures	0	0	0	0	1 (0.6)	0
Simple						
Skull	12 (5.6)	1 (1.3)	31 (8.9)	20 (5.6)	5 (3.1)	1 (2.5)
Nasal	0	0	0	0	1 (0.6)	0
Face	0	0	1 (0.3)	0	0	0
Maxilla	1 (0.4)	0	0	0	0	0
Jaw	4 (1.9)	0	7 (2.0)	3 (0.8)	2 (1.3)	2 (5.0)
Shoulder/Scapula	1 (0.4)	0	0	1 (0.3)	0	0
Clavicle	27 (12.5)	2 (2.6)	7 (2.0)	5 (1.4)	8 (5.0)	3 (7.5)
Arm	33 (15.3)	7 (9.1)	36 (10.3)	41 (11.5)	17 (10.7)	0
Humerus/Olecranon	3 (1.4)	0	0	0	0	0
Radius	4 (1.9)	0	0	0	0	0
Ulna	4 (1.9)	0	0	0	0	0
Wrist	0	0	0	2 (0.6)	0	0
Hand	0	0	1 (0.3)	0	0	0
Finger/Thumb	6 (2.8)	0	3 (0.9)	0	0	0
Rib	17 (7.9)	13 (16.9)	17 (4.9)	27 (7.6)	20 (12.6)	11 (27.5)
Spine/Back	0	0	1 (0.3)	1 (0.3)	1 (0.6)	2 (5.0)
Femur/Thigh	31 (14.4)	16 (20.8)	67 (19.2)	57 (16.0)	20 (12.6)	6 (15.0)
Leg	53 (24.5)	22 (28.6)	141 (40.4)	145 (40.6)	56 (35.2)	9 (22.5)
Knee/Patella	1 (0.4)	8 (10.4)	8 (2.3)	12 (3.4)	5 (3.1)	2 (5.0)
Tibia	0	0	0	1 (0.3)	0	0
Fibula	3 (1.4)	0	0	2 (0.6)	3 (1.9)	0
Ankle	0	0	0	3 (0.8)	0	0
Foot/Calcaneus	0	0	1 (0.3)	1 (0.3)	0	0
Toe	0	0	1 (0.3)	4 (1.1)	1 (0.6)	0
Multiple Fractures	4 (1.9)	0	8 (2.3)	1 (0.3)	3 (1.9)	2 (5.0)
Unknown	0	0	0	3 (0.8)	2 (1.3)	0
Total	**216**	**77**	**349**	**357**	**159**	**40**

Values in parentheses are percentages. The number of fractured elements / total number of male admissions for fracture at the hospital during the temporal period.

Table C.5 Fracture distribution by individual in females from the Middlesex and Royal London hospitals

Body Area	1760-1769		1770-1779	1780-1789	1790-1799	1800-1809
Compound	*Middlesex*	*Royal London*	*Middlesex*	*Middlesex*	*Royal London*	*Royal London*
Leg	6 (6.3)	0	2 (1.5)	5 (2.6)	9 (17.3)	0
Arm	1 (1.0)	0	0	1 (0.5)	2 (3.8)	0
Toe	0	0	0	1 (0.5)	0	0
Simple						
Skull	3 (3.1)	0	8 (6.0)	11 (5.8)	1 (1.9)	0
Jaw	1 (1.0)	0	0	1 (0.5)	0	0
Clavicle	11 (11.5)	2 (5.9)	3 (2.3)	0	1 (1.9)	0
Arm	22 (22.9)	6 (17.6)	26 (19.5)	17 (9.0)	6 (11.5)	0
Humerus/Olecranon	2 (2.1)	0	1 (0.8)	0	1 (1.9)	0
Radius	3 (3.1)	0	0	0	0	0
Ulna	2 (2.1)	0	0	0	0	0
Hand	1 (1.0)	0	0	0	0	0
Rib	10 (10.4)	1 (2.9)	5 (3.8)	10 (5.3)	4 (7.7)	2 (20.0)
Hip/Pelvis	0	0	2 (1.5)	0	0	0
Femur/Thigh	9 (9.4)	3 (8.8)	19 (14.3)	21 (11.1)	3 (5.8)	0
Leg	18 (18.8)	18 (52.9)	53 (39.8)	94 (49.7)	21 (40.4)	8 (80.0)
Knee/Patella	2 (2.1)	4 (11.8)	14 (10.5)	21 (11.1)	2 (3.8)	0
Tibia	1 (1.0)	0	0	0	0	0
Fibula	2 (2.1)	0	0	0	1 (1.9)	0
Ankle	0	0	0	2 (1.1)	0	0
Foot	0	0	0	2 (1.1)	0	0
Toe	0	0	0	0	0	0
Multiple Fractures	1 (1.0)	0	0	3 (1.6)	1 (1.9)	0
Unknown	1 (1.0)	0	0	0	0	0
Total	**96**	**34**	**133**	**189**	**52**	**10**

Values in parentheses are percentages. The number of fractured elements / total number of female admissions for fracture at the hospital during the temporal period.

To access the overall fracture patterning, the hospital admission results from the Middlesex and Royal London hospitals were pooled (full dataset available in Appendix C, Tables C.4 and C.5). Compound and simple fractures were pooled and organized into body areas, displayed in descending anatomical order from head to foot (Table C.6).

Table C.6 – Ranked fractured elements from the Middlesex and Royal London hospitals, organized by sex in descending anatomical order

Fractured Element	Males	Rank	Females	Rank
Skull/Head	70 (5.8)	5	23 (4.5)	6
Nose	1 (0.1)	14	0	-
Face	1 (0.1)	14	0	-
Maxilla	1 (0.1)	14	0	-
Jaw	**18 (1.5)**	8	2 (0.4)	9
Scapula/Shoulder	2 (0.2)	12	0	-
Clavicle	53 (4.4)	6	17 (3.3)	7
Arm	144 (12.0)	3	81 (15.8)	2
Humerus	2 (0.2)	13	3 (0.6)	8
Radius	4 (0.3)	11	3 (0.6)	8
Ulna/Olecranon	5 (0.4)	10	3 (0.6)	8
Hand	1 (0.1)	14	1 (0.2)	10
Wrist	2 (0.2)	13	0	-
Finger	**8 (0.7)**	9	0	-
Thumb	2 (0.2)	13	0	-
Rib/Ribs	**105 (8.8)**	4	32 (6.2)	5
Spine/Back	5 (0.4)	10	0	-
Hip	0	**-**	**2 (0.4)**	**9**
Thigh/Femur	**200 (16.7)**	2	55 (10.7)	3
Leg	489 (40.8)	1	234 (45.5)	1
Knee/Patella	36 (3.0)	7	**43 (8.4)**	**4**
Tibia	1 (0.1)	14	1 (0.2)	10
Fibula	8 (0.7)	9	3 (0.6)	8
Foot	1 (0.1)	14	2 (0.4)	9
Ankle	3 (0.3)	12	2 (0.4)	9
Toe	8 (0.7)	9	1 (0.2)	10
Calcaneus	1 (0.1)	14	0	-
Multiple Fractures	19 (1.6)		5 (1.0)	
Unknown	8 (0.7)		1 (0.2)	
Total	**1198**		**514**	

Values in parentheses are percentages. Number of fractured elements / total number of fractured elements. Bolded values are statistically significant ($p < 0.05$).

From Table C.6, it is evident that legs are the most frequently fractured element in both the male and female datasets. The male sample was most frequently affected by leg and thigh/femoral fractures, arm fractures, rib fractures, and skull fractures. The top five fractures for the female group were leg fractures, arm fractures, thigh/femoral fractures, knee/patellar fractures, and rib fractures. Z-tests for two population proportions were performed upon the data in Table 4.8 using the total number of admitted males and females. There is a statistically significant difference between the male and female groups for several skeletal elements. There were significantly higher proportions of jaw, finger, rib, and thigh/femur fractures in the male group and a higher proportion of hip and knee/patella fractures in the female group.

Table C.7 Chi square comparison of males and females admitted with cranial fractures

	Fractured	Not fractured	Total
Male	91	6556	6647
Female	25	3247	3272
Total	116	9803	9919

Chi square statistic: 6.9434. P value: 0.008413. Significant at $p < 0.05$.

Table C.8 Chi square comparison of males and females admitted with torso fractures

	Fractured	Not fractured	Total
Male	110	6537	6647
Female	32	3240	3272
Total	142	9777	9919

Chi square statistic: 7.1194. P value: 0.007625. Significant at $p < 0.05$.

Table C.9 Chi square comparison of males and females admitted with arm fractures

	Fractured	Not fractured	Total
Male	155	6492	6647
Female	90	3182	3272
Total	245	9674	9919

Chi square statistic: 1.5959. P value: 0.206484. Not significant at $p < 0.05$.

Table C.10 Chi square comparison of males and females admitted with hand fractures

	Fractured	Not fractured	Total
Male	13	6634	6647
Female	1	3271	3272
Total	14	9905	9919

Chi square statistic: 4.2361. P value: 0.039572. Significant at $p < 0.05$.

Table C.11 Chi square comparison of males and females admitted with leg fractures

	Fractured	Not fractured	Total
Male	734	5913	6647
Female	338	2934	3272
Total	1072	8847	9919

Chi square statistic: 1.1548. P value: 0.282557. Not significant at $p < 0.05$.

Table C.12 Chi square comparison of males and females admitted with foot fractures

	Fractured	Not fractured	Total
Male	13	6634	6647
Female	5	3267	3272
Total	18	9901	9919

Chi square statistic: 0.2214. P value: 0.637991. Not significant at $p < 0.05$.

Length of Hospital Stay

Clinically, males suffer compound fractures more often than females (ratio of 4:1), with the hands, legs, forearm, and feet most commonly affected (Cunha, Braga, Abrahao, Vilela, & Las Casas Silva, 1998). The tibial diaphysis is the most common open fracture site in adult males; fractures to the lower limbs are considered more dangerous due to the accompanying musculoskeletal trauma (Court-Brown, Rimmer, Prakash, & McQueen, 1998).

Table C.13 Average number of days in hospital organized by closed fracture location

	Males					Females				
Fracture Location	Royal London	Middlesex	St. T	Guy's	Mean	Royal London	Middlesex	St. T	Guy's	Mean
Skull/Head/ Cranium	23	49.6	56.2	70.1	56	7	71.6	36	31	48.4
Eye/Zygomatic	-	-	-	17	17	-	-	-	31	31
Maxilla	-	24	-	-	24	-	-	-	-	-
Nose	15	-	-	10.5	12	-	-	-	31.5	31.5
Jaw	32	27.8	33.2	34.4	32.9	-	27	36	24.2	25.5
Neck	-	-	-	-	-	-	-	-	83	83
Clavicle	21.8	30	43.4	30.6	32.6	26.3	31.5	57	31.9	32.1
Scapula/Shoulder	-	99	26.7	27.2	31	-	-	29	96.8	74.2
Arm	31.1	39.8	50.7	46.3	46	32.8	62.8	48.1	49.2	50.4
Humerus	-	97	50	46	49.7	8	62	-	32.3	33.2
Radius	-	-	-	27.5	27.5	-	-	-	19	19
Ulna	-	-	-	44.5	44.5	-	-	-	-	-
Elbow	-	-	29	36.8	34.6	-	-	15	75	55
Wrist	-	51	45.8	-	47.3	-	-	143.3	18.5	93.4
Hand/Metacarpal	-	9	-	24.4	21.8	-	-	-	13	13
Finger/Thumb	-	32	62.8	44.7	47.1	-	-	-	42.3	42.3
Sternum	-	-	-	17.3	17.3	-	-	-	-	-
Rib/Ribs	23.7	22.5	35.2	30.5	30.0	20	22.8	34.3	22	23.1
Spine	-	-	176	293.3	234.7	-	-	-	-	-
Hip	-	-	15	92	66.3	-	25	-	-	25
Ilium/Pelvis	-	-	-	56.3	56.3	-	-	-	-	-
Femur/Thigh	52.6	64.4	77	85.8	78	60.3	65.3	77.5	73.3	71.3
Tibia	-	33	-	69.7	66.4	-	-	-	63	63
Fibula	38	36.5	-	66.5	47.8	40	34.5	-	64	43.3
Leg	59.6	58.6	75.7	68.3	66.9	51.8	66.4	81.1	70.1	68.2
Knee/Patella	40.7	44.7	52.6	74	63.5	61.4	65.3	66.6	69	66.5
Ankle	-	34.7	47.2	35.2	39.4	-	73	41.3	47	47.3
Foot/Toe/ Calcaneus	105	23.6	46.8	51.1	47.5	-	21	36	7	21.3
Stump	-	-	-	10	10	-	-	-	-	-
Multiple Elements	82.8	64.5	85	87.9	80.1	64	133	-	60	85.7
Fracture (unknown)	35	52.7	-	66.6	60	-	-	-	-	-

Table C.13 displays the average length of hospital stays for individuals entering the hospital with a closed fracture. The longest average hospital stay for males was fractures of the back and/or spine at 234.7 days (n=6). Closed fractures of the lower limbs generally resulted in longer average hospital stays than fractures of the upper limbs. For instance, fractures to the femur/thigh in males resulted in an average hospital stay of 78 days (n=569), versus the average hospital stay of 49.7 days for a humeral fracture (n=15). Fractures resulting in shorter hospital stays were to elements such as the nose and facial skeleton (nasal, 12 days, n=3; eye/zygomatic, 17 days, n=2; maxilla, 24 days, n=1) and the sternum (17.3 days, n=4). For females, the longest average hospital stay was for wrist fractures (93.4 days, n=5), due to an outlier. With the outlier removed, the average hospital stay drops to 29 days. Similarly, the average hospital stay for fractures to the scapulae/shoulders (74.2 days, n=6) is much higher than the males due to an outlier. When the outlying individual is removed the new average hospital stay for females is 49.4 days. Similar to the male results, the average hospital stays for fractured femora/thighs (71.3 days, n=148) and the other lower limb bones are generally longer than fractures to the upper limb (e.g., arm, 50.4 days, n=269).

Table C.14 Average number of days in hospital organized by compound fracture location

	Males					Females				
Fracture Location	Royal London	Middlesex	St. T	Guy's	Mean	Royal London	Middlesex	St. T	Guy's	Mea
Skull	-	-	-	41	41	-	-	-	-	-
Face/Nose	-	-	-	113.5	113.5	-	-	-	-	-
Jaw	-	-	-	115	115	-	-	-	161	16
Clavicle	-	253	-	94	173.5	-	-	-	-	-
Arm	101	63	57	103.9	90.5	16	33	-	65	44
Finger/Hand/ Thumb	-	-	-	40	40	-	-	-	39	3
Femur/Thigh	-	144	-	118	120.9	-	-	-	108	10
Leg/Tibia	128.1	113.7	114.2	126.2	121.4	81.6	109.2	-	161.4	116
Foot/Toe	10	17	-	45.2	36.1	-	57	-	38	47
Multiple Elements	-	-	-	-	-	-	-	-	-	-
Fracture/Fractured	-	69.5	-	158	99	-	-	-	-	-

Table C.14 displays the average length of stay for individuals who suffered a compound fracture and sought treatment at the Middlesex or the Royal London. An outlier in both the face/nose (n=4) and clavicle (n=2) categories caused the average length of stay for those compound fractured elements in males to be relatively high (113.5 and 173.5 days respectively). With the outliers removed the average lengths of stay are 38.7 days for compound face/nose fractures and 94 days for compound clavicle fractures. The average length of stay for long bones of the leg (femur/thigh, n=9; leg/tibia, n=95) in males resulted in a hospital stay of 120.9 and 121.4 days respectively, whereas compound fractures of the arm (n=17) resulted in an average stay of 90 days. The element with the longest average hospital stay was for a female (n=1) with a compound jaw fracture. As found in the male sample, the average hospital stay for compound fractures of the long bones (108 days, femur/thigh, n=1; 116.9 days, leg/tibia, n=16) was longer than that for a compound fracture of the arm at 44.8 days (n=4).

The data regarding length of stay in the hospitals were also interrogated to study the relative fatality of fracture types. Admissions for the Royal London and the Middlesex Hospital listed a result for the majority of hospital admissions (e.g., died, cured, made outpatient) and, therefore, it is possible to determine what proportion of compound and closed fracture types were fatal at these institutions. The pooled Royal London and Middlesex data are found in Table C.15.

Table C.15 Proportion of fatal fractures from the Royal London and the Middlesex hospitals

	Males		**Females**	
Fracture Location	Fatal fractures	Total fractures	Fatal fractures	Total fractures
Compound Fractures				
Arm	-	-	1 (20.0%)	5
Thigh	1 (50.0%)	2	-	-
Leg	16 (28.6%)	56	6 (35.3%)	17
Closed Fractures				
Skull/Head	24 (44.4%)	54	8 (44.4%)	18
Spine/Back	5 (100%)	5	-	-
Arm	3 (3.5%)	86	2 (3.7%)	54
Rib	9 (10.5%)	86	-	-
Thigh	10 (6.2%)	161	4 (8.9%)	45
Leg	10 (2.7%)	370	7 (3.9%)	181
Knee/Patella	2 (6.5%)	31	1 (3.1%)	32
Toe	1 (20.0%)	5	-	-

Spine or back fractures had the highest proportion (100%) of fatality at the Royal London and Middlesex Hospitals. Interestingly, there were individuals who entered St. Thomas' and Guy's Hospitals with spinal fractures that were eventually discharged, but the five individuals who were admitted to the Middlesex or the Royal London were all fatalities.

There were only two compound femoral fractures in the Royal London and Middlesex admissions, but one was fatal for a proportion of 50.0% fatality. Fractures of the skull were fatal in 44.4% of cases for both males and females. Chi-square tests were performed and compound fractures of the leg were statistically significantly more likely to be fatal than closed fractures of the leg for both males and females ($p < 0.05$). Differences between thigh and arm fractures were not significantly different.

Age at Admission at the Royal London Hospital

Age at admission was reported in the Royal London Hospital admission books for 1760, 1791, and 1792. The data are summarized in Table C.16.

Table C.16 Age at admission for individuals admitted to the Royal London Hospital (1760, 1791, 1792)

Age at Admission	**Number of Admissions n (%)**
Subadult (<18)	423 (11.6%)
YA (18-25)	841 (23.1%)
MA1 (26-35)	837 (23.0%)
MA2 (36-45)	701 (19.3%)
OA (46+)	781 (21.5%)
Adult	51 (1.4%)
Total	**3634**

Middlesex Hospital Admissions Charted by Season

Figure C.1 Male admissions for cranial fractures to the Middlesex Hospital

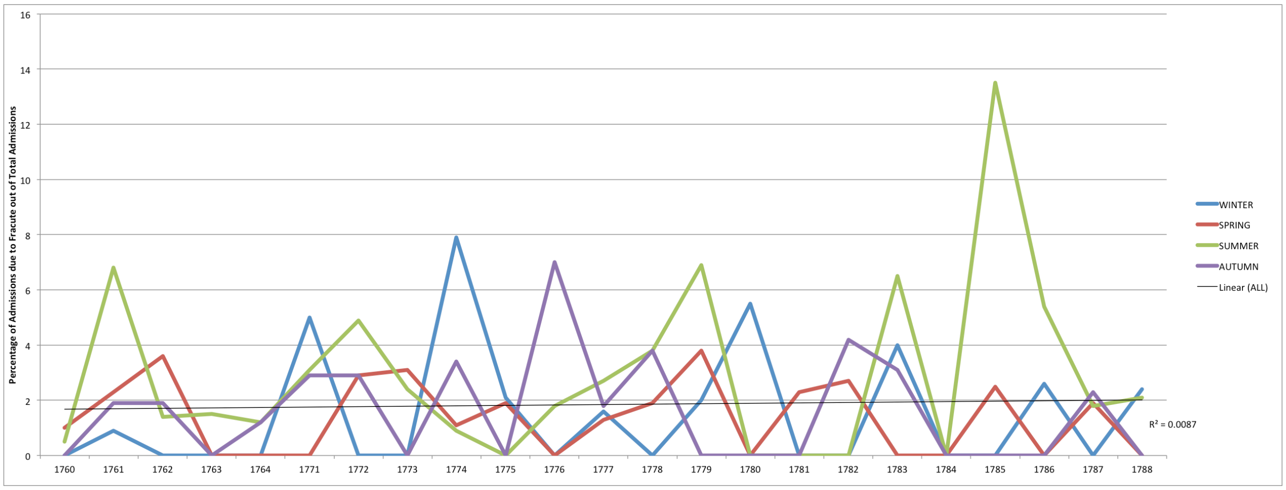


Figure C.2 Female admissions for cranial fractures to the Middlesex Hospital

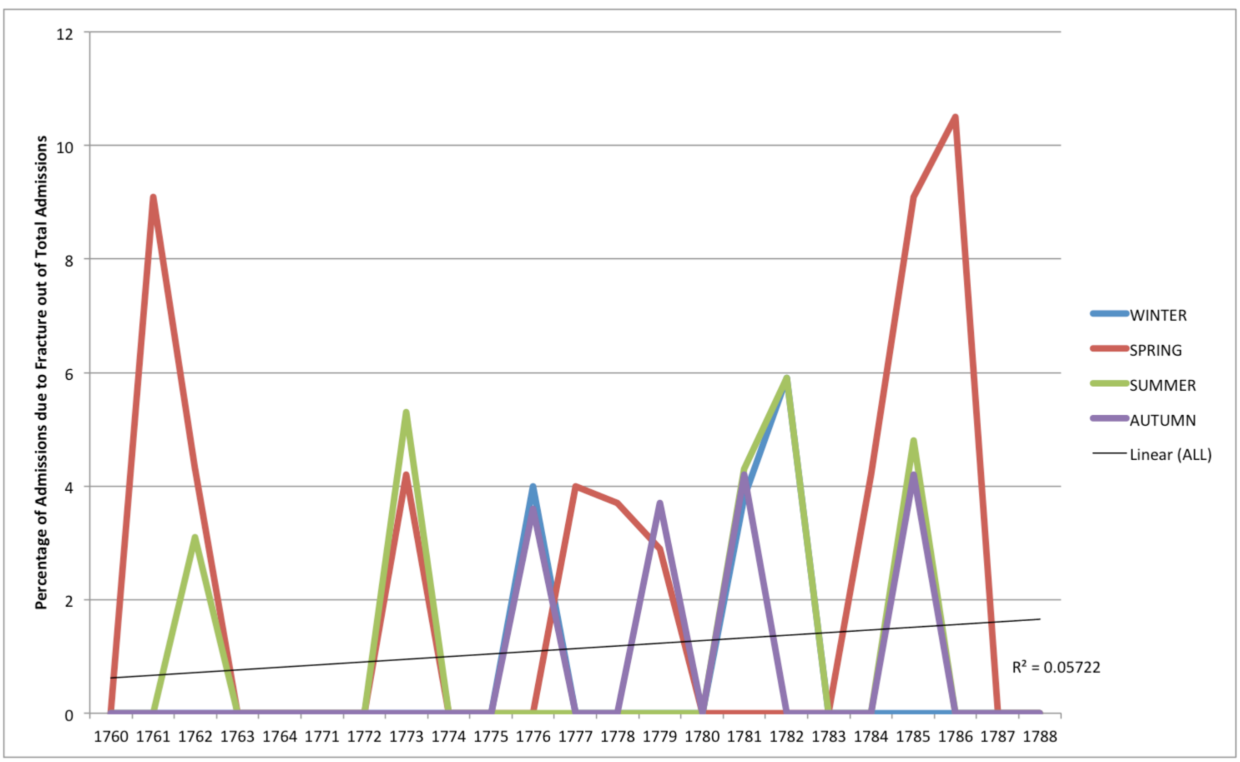


Figure C.3 Male admissions for torso fractures to the Middlesex Hospital

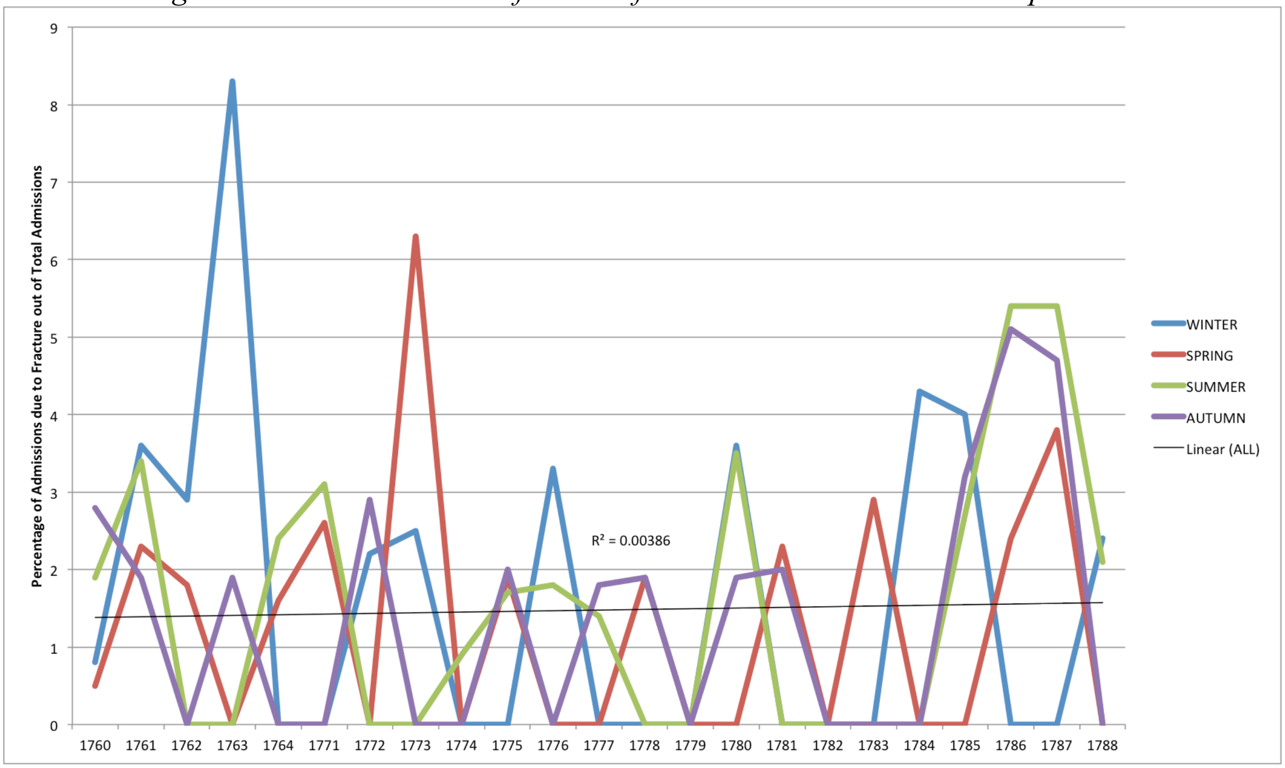


Figure C.4 Female admissions for torso fractures to the Middlesex Hospital

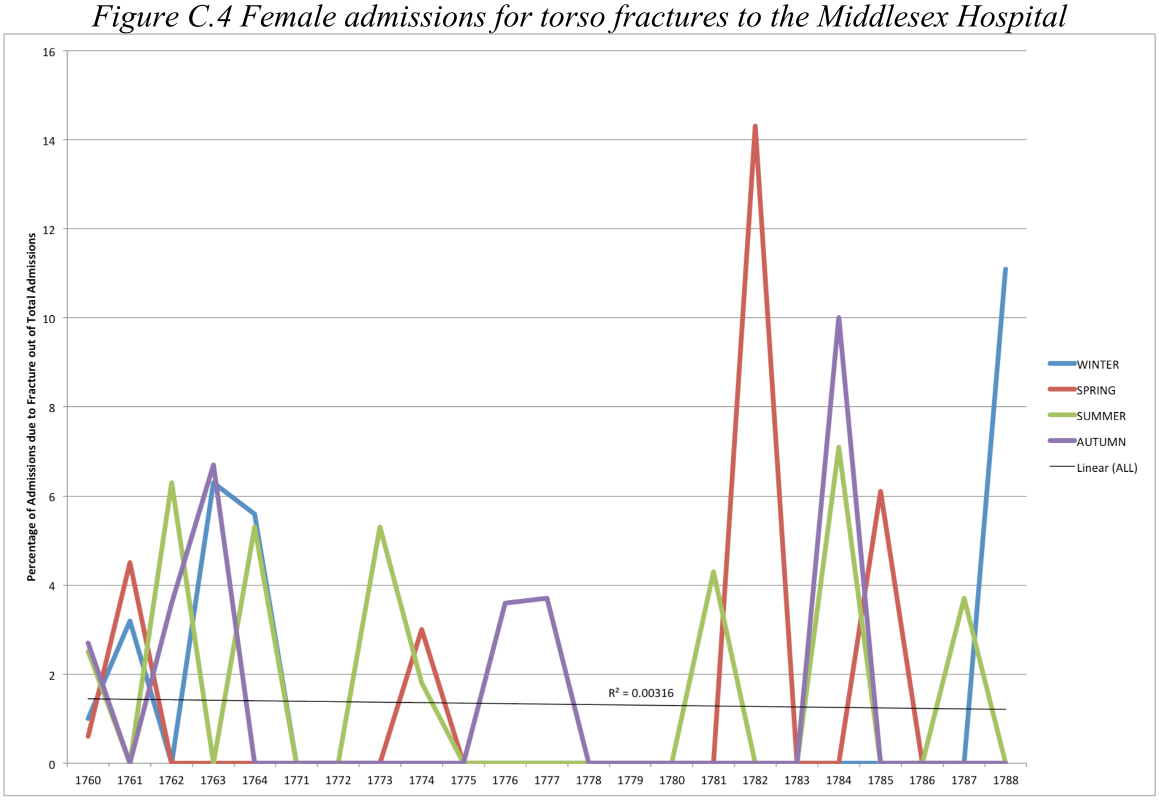


Figure C.5 Male admissions for arm fractures to the Middlesex Hospital

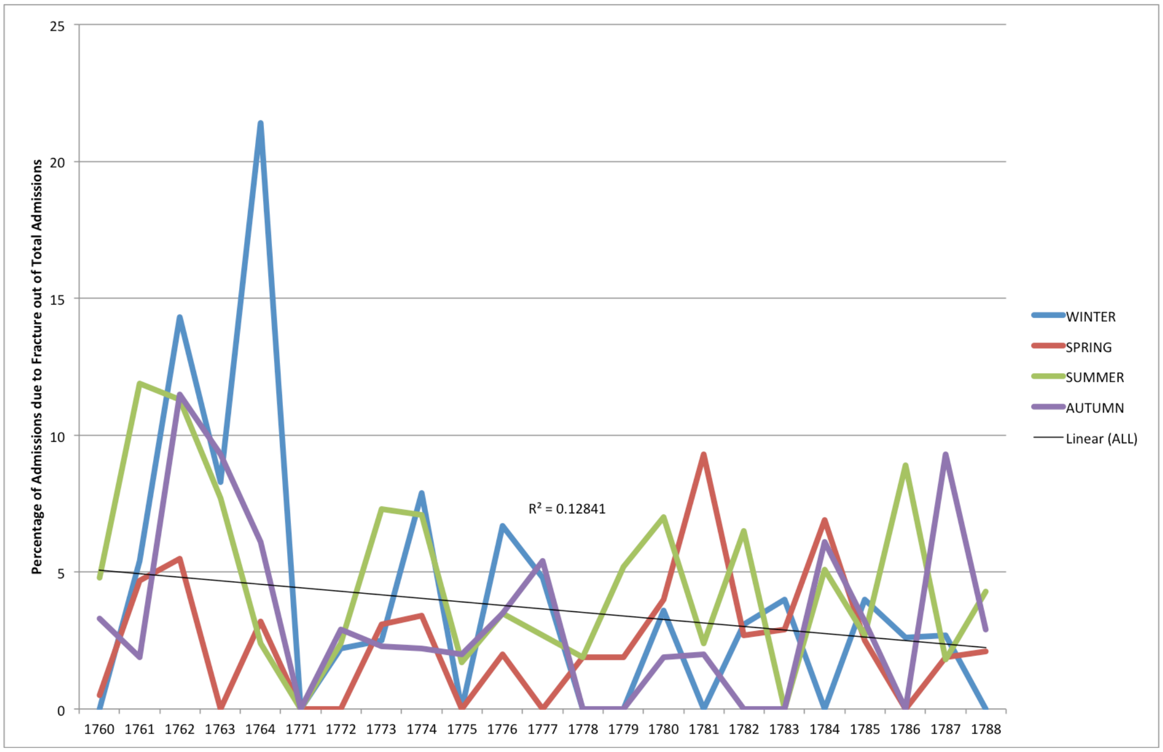


Figure C.6 Female admissions for arm fractures to the Middlesex Hospital

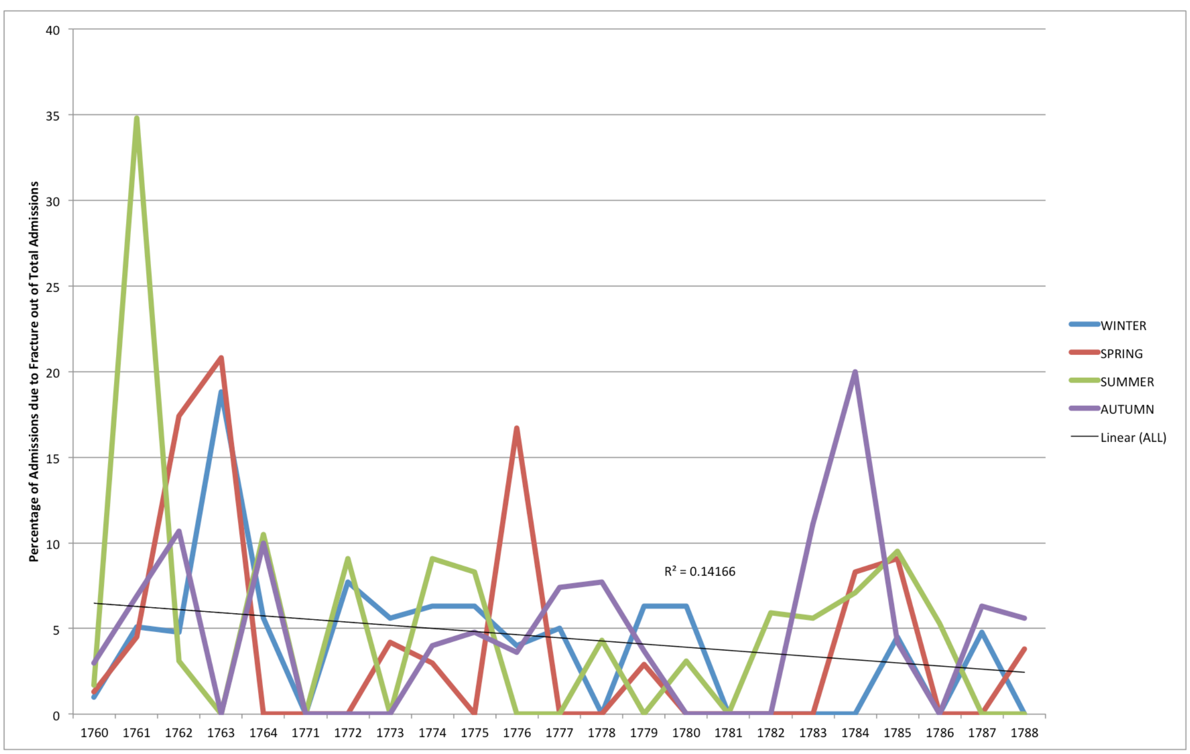


Figure C.7 Male admissions for hand fractures to the Middlesex Hospital

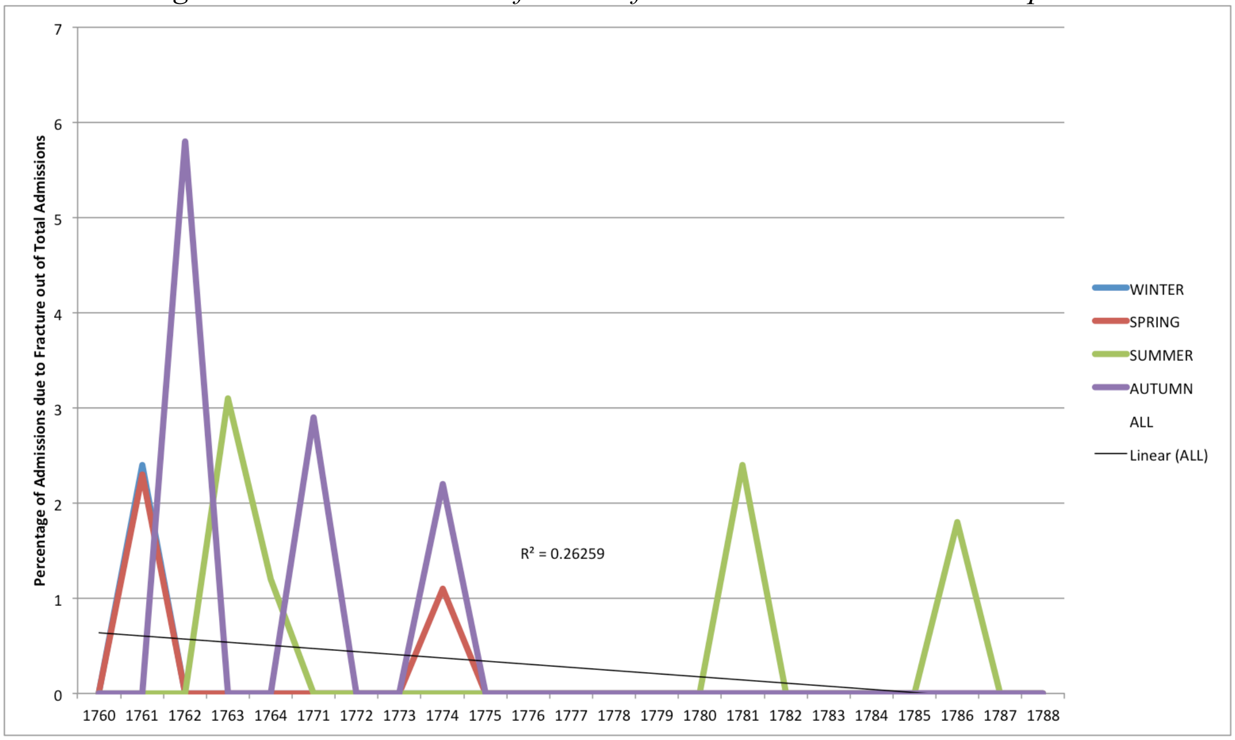


Figure C.8 Male admissions for foot fractures to the Middlesex Hospital

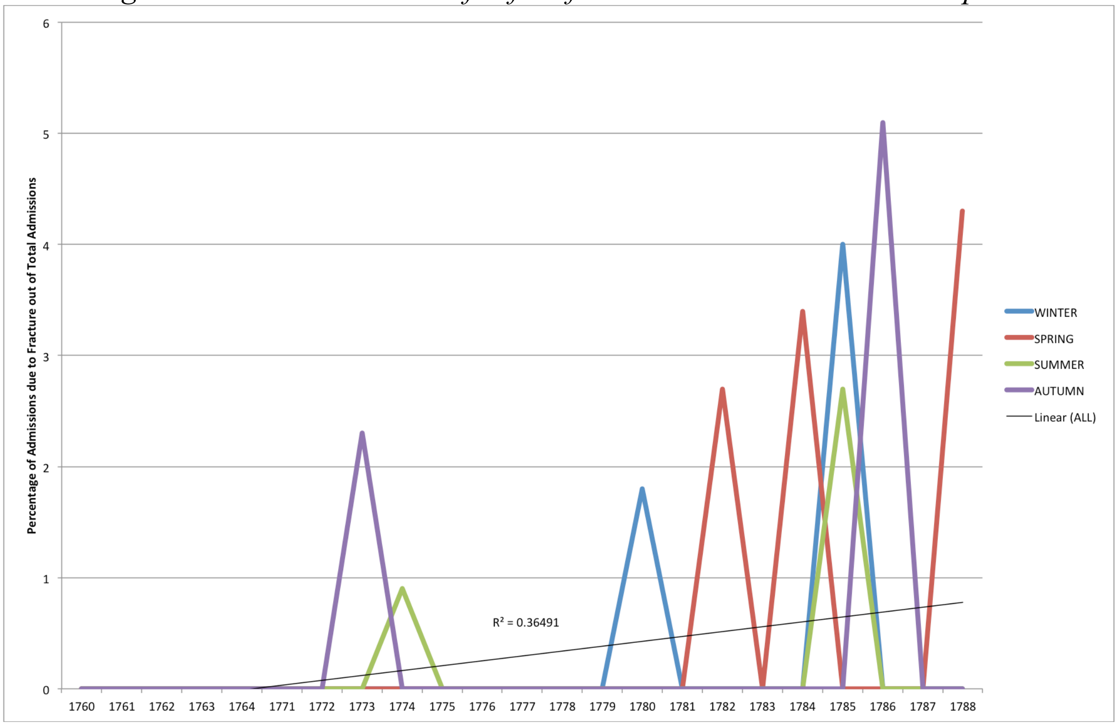
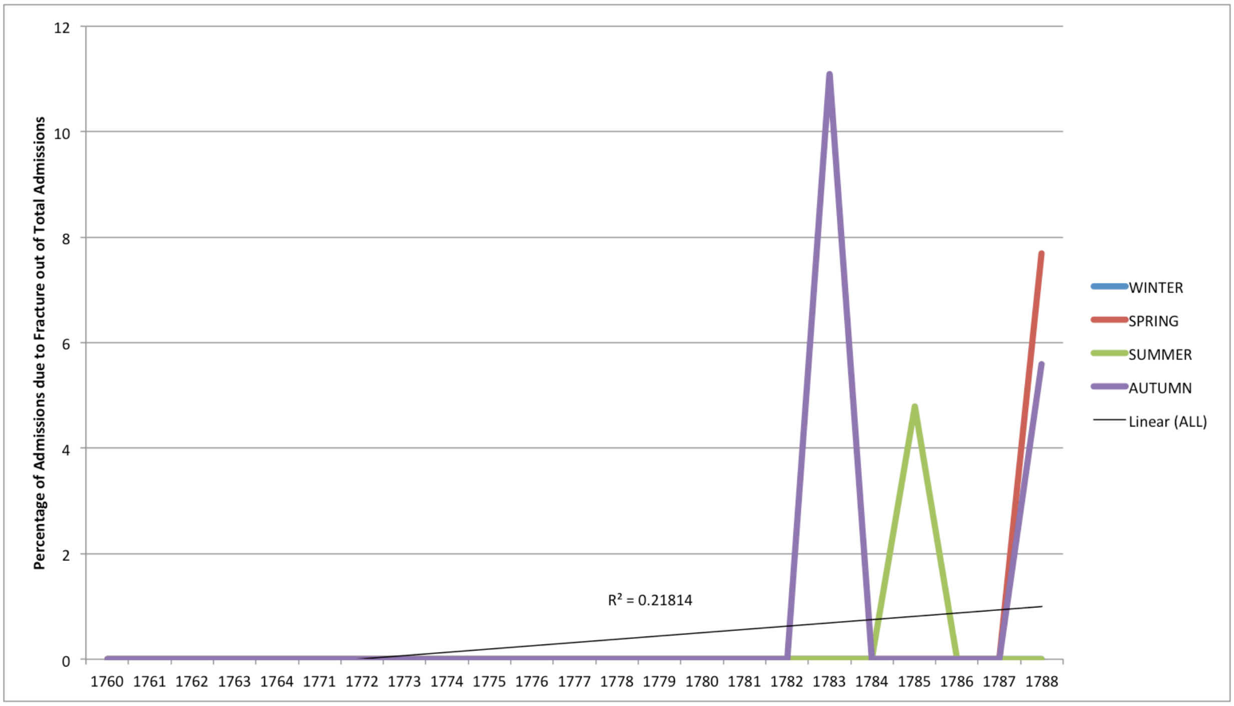


Figure C.9 Female admissions for foot fractures to the Middlesex Hospital



APPENDIX D – Raw Bone Segment Data

Table D.1 – Bone segments present for male skeletal sample by skeletal collection

Element	Segment	FAO90	PAY05	BBP07	REW92	NLB91	RLP05	Total
Femur L	Proximal	133	63	15	11	30	64	316
	Mesial	129	63	15	11	31	63	312
	Distal	124	63	15	10	28	65	305
Femur R	Proximal	137	63	16	10	33	64	323
	Mesial	135	62	16	11	30	66	320
	Distal	127	60	16	10	30	61	304
Tibia L	Proximal	109	63	15	8	26	62	283
	Mesial	110	63	15	11	29	62	290
	Distal	108	63	15	11	26	61	284
Tibia R	Proximal	108	58	14	9	24	57	270
	Mesial	111	59	14	11	27	56	278
	Distal	109	59	14	11	26	55	274
Fibula L	Proximal	99	58	13	8	22	56	256
	Mesial	105	62	13	9	28	55	272
	Distal	103	63	14	9	21	55	265
Fibula R	Proximal	102	59	14	10	24	53	262
	Mesial	105	60	14	11	27	53	270
	Distal	103	59	15	10	25	52	264
Humerus L	Proximal	131	64	16	9	30	63	313
	Mesial	133	65	16	11	32	67	324
	Distal	135	65	16	11	33	67	327
Humerus R	Proximal	131	65	15	9	27	57	304
	Mesial	137	65	15	12	29	60	318
	Distal	138	65	16	11	28	63	321
Radius L	Proximal	131	59	14	10	26	62	302
	Mesial	132	60	14	10	30	63	309
	Distal	130	59	15	9	31	61	305
Radius R	Proximal	132	59	15	9	27	65	307
	Mesial	137	60	16	10	31	65	319
	Distal	132	60	16	10	28	64	310
Ulna L	Proximal	139	61	15	10	32	63	320
	Mesial	137	60	15	11	31	62	316
	Distal	131	59	15	11	29	61	306
Ulna R	Proximal	137	63	16	11	28	65	320
	Mesial	139	62	16	10	28	65	320
	Distal	135	61	16	12	28	63	315
Clavicle L	Proximal	132	60	14	10	27	64	307

	Mesial	139	60	14	11	30	66	320
	Distal	137	60	15	11	29	67	319
Clavicle R	Proximal	133	60	14	11	26	63	307
	Mesial	141	60	15	12	26	66	320
	Distal	137	60	13	12	25	59	306
Mandible L	-	144	61	14	11	28	56	314
Mandible R	-	141	61	14	11	28	54	309
Maxilla L	-	123	60	12	11	26	55	287
Maxilla R	-	127	59	12	11	27	54	291
Nasal L	-	91	54	7	12	9	34	205
Nasal R	-	91	54	7	10	9	33	202
Scapula L	Glenoid	137	59	15	11	25	60	307
	Coracoid	120	54	6	11	14	42	247
	Acromion	128	54	10	11	28	52	283
	Infraspinous	138	59	11	11	30	66	315
Scapula R	Glenoid	138	58	11	10	20	60	297
	Coracoid	119	52	8	9	11	49	248
	Acromion	136	57	12	11	20	54	290
	Infraspinous	141	56	12	11	25	62	307
Patella L	-	85	41	10	8	23	44	211
Patella R	-	85	41	10	9	24	44	213
Sternum	-	91	47	8	5	14	53	218
Ilium L	-	143	63	15	10	30	70	331
Ilium R	-	147	63	16	11	31	68	336
Ischium L	-	127	61	13	9	30	66	306
Ischium R	-	129	61	10	10	31	60	301
Pubis L	-	90	50	11	7	18	31	207
Pubis R	-	89	54	9	7	20	38	217
Zygomatic L	-	124	60	13	12	25	54	288
Zygomatic R	-	114	63	13	12	27	54	283
L metacarpal 1	-	98	48	12	9	26	46	239
L metacarpal 2	-	102	55	13	11	31	52	264
L metacarpal 3	-	106	57	14	11	30	52	270
L metacarpal 4	-	94	50	12	7	27	49	239
L metacarpal 5	-	95	49	12	10	26	49	241

R metacarpal 1	-	102	54	11	11	28	51	257
R metacarpal 2	-	108	57	14	9	29	55	272
R metacarpal 3	-	109	54	14	10	28	54	269
R metacarpal 4	-	110	56	12	11	26	50	265
R metacarpal 5	-	104	50	12	11	25	52	254
L Proximal Manual Phalanx	-	454	153	36	34	122	43	842
L Intermediate Manual Phalanx	-	286	71	12	21	71	31	492
L Distal Manual Phalanx	-	205	15	4	8	49	17	298
R Proximal Manual Phalanx	-	422	158	40	37	121	40	818
R Intermediate Manual Phalanx	-	281	76	14	21	81	27	500
R Distal Manual Phalanx	-	206	16	6	13	65	20	326
Unsided Proximal Manual Phalanx	-	112	144	37	16	19	401	729
Unsided Intermediate Manual Phalanx	-	78	101	43	19	12	255	508
Unsided Distal Manual Phalanx	-	45	89	16	27	7	190	374
L metatarsal 1	-	91	57	12	9	21	50	240
L metatarsal 2	-	89	53	11	11	22	48	234
L metatarsal 3	-	91	51	11	11	20	46	230
L metatarsal 4	-	84	53	11	11	24	49	232
L metatarsal 5	-	85	49	13	10	22	46	225
R metatarsal 1	-	91	55	13	9	20	43	231
R metatarsal 2	-	94	53	10	10	22	45	234
R metatarsal 3	-	96	52	11	9	22	44	234
R metatarsal 4	-	89	53	10	9	21	42	224
R metatarsal 5	-	94	51	10	9	23	46	233
L proximal pedal phalanx	-	308	127	16	25	67	51	594

L intermediate pedal phalanx	-	35	3	0	3	8	2	51
L distal pedal phalanx	-	101	26	2	10	22	26	187
R proximal pedal phalanx	-	315	139	17	22	68	50	611
R intermediate pedal phalanx	-	39	3	0	3	9	1	55
R distal pedal phalanx	-	122	29	1	10	26	21	209
Unsided proximal pedal phalanx	-	56	100	36	30	12	271	505
Unsided intermediate pedal phalanx	-	7	18	3	4	2	27	61
Unsided distal pedal phalanx	-	19	19	4	9	5	35	91
L scaphoid	-	85	32	9	6	22	44	198
L lunate	-	79	28	3	4	22	36	172
L triquetral	-	59	25	5	4	18	23	134
L pisiform	-	34	10	0	5	15	18	82
L trapezium	-	67	23	4	6	13	38	151
L trapezoid	-	60	25	3	4	20	32	144
L capitate	-	73	32	8	8	23	48	192
L hamate	-	88	32	7	6	23	40	196
R scaphoid	-	96	38	10	8	21	42	215
R lunate	-	83	36	9	8	19	39	194
R triquetral	-	64	18	5	5	20	28	140
R pisiform	-	36	13	1	6	14	19	89
R trapezium	-	76	29	6	7	19	34	171
R trapezoid	-	72	27	5	9	24	31	168
R capitate	-	90	45	9	10	23	42	219
R hamate	-	84	32	7	10	25	42	200
L calcaneus	-	90	57	12	10	22	47	238

L talus	-	91	53	11	10	25	47	237
L navicular	-	73	46	9	9	24	44	205
L cuboid	-	79	43	9	11	19	37	198
L medial cuneiform	-	80	43	8	11	19	38	199
L intermediate cuneiform	-	74	40	5	8	20	32	179
L lateral cuneiform	-	72	34	6	8	18	36	174
R calcaneus	-	95	56	14	11	26	51	253
R talus	-	95	54	14	12	25	51	251
R navicular	-	87	42	12	10	23	40	214
R cuboid	-	90	43	9	8	19	42	211
R medial cuneiform	-	88	51	11	8	21	41	220
R intermediate cuneiform	-	71	34	8	8	19	33	173
R lateral cuneiform	-	69	42	8	8	20	35	182
R ribs	-	1358	644	115	104	223	737	3181
L ribs	-	1459	629	133	111	219	738	3289
Unsided ribs	-	1	1	0	5	4	3	14
Cervical vertebrae	Whole	890	381	76	73	142	389	1951
	Body only	15	2	6	0	16	16	55
	Neural arch only	6	3	3	3	9	34	58
Thoracic vertebrae	Whole	1633	690	121	96	139	699	3378
	Body only	43	15	13	6	115	62	254
	Neural arch only	17	7	12	25	25	123	209
Lumbar vertebrae	Whole	682	288	59	34	86	327	1476
	Body only	21	6	5	6	27	12	77

	Neural arch only	12	3	2	9	22	41	89
Sacral segment 1	Whole	131	60	12	8	22	63	296
	Body only	2	0	1	0	5	0	8
	Neural arch only	1	0	1	2	0	7	11

Table D.2 – Bone segments present for female skeletal sample by skeletal collection

Element	Segment	FAO90	PAY05	BBP07	REW92	NLB91	RLP05	Total
Femur L	Proximal	98	86	22	24	23	27	280
	Mesial	98	86	22	25	23	26	280
	Distal	96	85	22	25	22	26	276
Femur R	Proximal	98	85	22	25	24	27	281
	Mesial	99	87	22	27	23	27	285
	Distal	95	86	22	24	21	27	275
Tibia L	Proximal	75	85	22	23	17	22	244
	Mesial	79	85	22	24	22	22	254
	Distal	74	85	22	24	18	22	245
Tibia R	Proximal	72	85	21	25	18	25	246
	Mesial	75	86	22	25	23	25	256
	Distal	73	84	22	26	18	23	246
Fibula L	Proximal	68	78	21	21	16	22	226
	Mesial	72	81	21	23	22	21	240
	Distal	68	79	22	22	18	22	231
Fibula R	Proximal	67	79	20	26	18	24	234
	Mesial	74	81	22	27	24	22	250
	Distal	70	80	21	25	18	22	236
Humerus L	Proximal	102	85	21	21	16	25	270
	Mesial	104	86	21	25	20	26	282
	Distal	105	86	21	25	22	26	285
Humerus R	Proximal	96	87	20	25	16	24	268
	Mesial	100	87	20	26	23	25	281
	Distal	100	87	20	25	22	25	279
Radius L	Proximal	102	82	21	25	19	24	273
	Mesial	104	83	21	27	24	24	283
	Distal	101	84	21	24	20	24	274
Radius R	Proximal	91	82	20	24	19	24	260

	Mesial	92	84	20	26	25	24	271
	Distal	91	81	21	23	21	24	261
Ulna L	Proximal	99	80	22	26	22	24	273
	Mesial	99	81	22	26	24	24	276
	Distal	98	74	21	24	20	25	262
Ulna R	Proximal	91	82	22	27	24	23	269
	Mesial	92	82	22	25	23	23	267
	Distal	90	75	20	22	20	22	249
Clavicle L	Proximal	100	77	18	25	18	23	261
	Mesial	102	80	20	26	19	23	270
	Distal	101	75	18	26	17	23	260
Clavicle R	Proximal	92	79	20	25	18	23	257
	Mesial	95	81	21	26	18	22	263
	Distal	95	81	19	23	19	20	257
Mandible L	-	95	83	20	25	20	20	263
Mandible R	-	100	84	20	25	21	20	270
Maxilla L	-	83	79	17	22	17	20	238
Maxilla R	-	82	77	19	23	17	19	237
Nasal L	-	58	62	10	14	2	13	159
Nasal R	-	58	64	11	12	3	12	160
Scapula L	Glenoid	101	78	20	24	16	19	258
	Coracoid	92	63	15	19	11	12	212
	Acromion	98	74	16	23	13	21	245
	Infraspinous	102	73	18	26	16	23	258
Scapula R	Glenoid	98	80	19	26	12	21	256
	Coracoid	84	65	12	23	7	14	205
	Acromion	93	71	14	25	14	17	234
	Infraspinous	97	79	17	27	17	22	259
Patella L	-	64	52	14	16	18	19	183
Patella R	-	66	57	14	18	19	14	188
Sternum	-	66	51	13	12	13	17	172
Ilium L	-	112	86	23	26	23	27	297
Ilium R	-	111	86	22	27	24	27	297
Ischium L	-	97	77	19	24	20	24	261
Ischium R	-	94	76	18	24	21	26	259
Pubis L	-	64	56	9	10	13	15	167
Pubis R	-	65	54	11	10	12	16	168
Zygomatic L	-	78	83	17	24	15	18	235
Zygomatic R	-	76	78	18	24	17	18	231

L metacarpal 1	-	80	64	11	15	17	24	211
L metacarpal 2	-	87	72	18	20	22	23	242
L metacarpal 3	-	84	74	16	20	21	20	235
L metacarpal 4	-	80	69	14	19	20	25	227
L metacarpal 5	-	72	67	11	17	18	22	207
R metacarpal 1	-	83	67	18	14	22	18	222
R metacarpal 2	-	79	75	20	19	23	23	239
R metacarpal 3	-	80	72	20	21	26	22	241
R metacarpal 4	-	77	67	14	19	26	22	225
R metacarpal 5	-	78	63	16	19	23	19	218
L Proximal Manual Phalanx	-	310	178	46	64	88	23	709
L Intermediate Manual Phalanx	-	71	31	6	11	24	5	148
L Distal Manual Phalanx	-	129	6	5	14	33	5	192
R Proximal Manual Phalanx	-	322	195	47	66	100	21	751
R Intermediate Manual Phalanx	-	186	68	13	25	61	13	366
R Distal Manual Phalanx	-	124	10	7	15	36	7	199
Unsided Proximal Manual Phalanx	-	104	241	43	37	10	159	594
Unsided Intermediate Manual Phalanx	-	57	158	27	55	14	96	407
Unsided Distal Manual Phalanx	-	28	81	17	43	7	76	252
L metatarsal 1	-	66	72	19	20	17	18	212
L metatarsal 2	-	59	68	18	21	16	17	199
L metatarsal 3	-	60	70	18	20	16	17	201
L metatarsal 4	-	57	72	15	17	14	16	191
L metatarsal 5	-	58	64	18	16	13	15	184
R metatarsal 1	-	62	70	20	21	14	18	205

R metatarsal 2	-	58	70	20	20	16	19	203
R metatarsal 3	-	58	67	18	20	16	18	197
R metatarsal 4	-	59	68	17	18	17	19	198
R metatarsal 5	-	56	65	17	18	15	22	193
L proximal pedal phalanx	-	200	125	21	31	38	15	430
L intermediate pedal phalanx	-	22	0	0	2	5	0	29
L distal pedal phalanx	-	50	25	6	7	14	11	113
R proximal pedal phalanx	-	60	58	15	17	20	17	187
R intermediate pedal phalanx	-	26	0	0	2	7	0	35
R distal pedal phalanx	-	67	29	5	6	19	7	133
Unsided proximal pedal phalanx	-	58	200	43	67	9	98	475
Unsided intermediate pedal phalanx	-	7	16	1	12	2	8	46
Unsided distal pedal phalanx	-	16	12	9	17	0	13	67
L scaphoid	-	68	39	6	14	18	17	162
L lunate	-	46	27	3	11	17	16	120
L triquetral	-	48	21	1	8	11	10	99
L pisiform	-	30	10	1	6	7	2	56
L trapezium	-	52	28	3	11	10	11	115
L trapezoid	-	45	21	2	12	10	13	103
L capitate	-	56	40	6	18	18	16	154
L hamate	-	64	34	4	14	17	15	148
R scaphoid	-	63	28	8	13	19	18	149
R lunate	-	52	32	4	11	17	16	132
R triquetral	-	45	20	3	9	13	9	99
R pisiform	-	19	8	2	9	6	6	50

R trapezium	-	45	27	3	12	15	15	117
R trapezoid	-	41	18	3	13	11	10	96
R capitate	-	54	35	8	18	18	19	152
R hamate	-	59	38	6	14	22	14	153
L calcaneus	-	64	74	19	20	14	17	208
L talus	-	65	75	17	22	14	20	213
L navicular	-	59	60	15	20	15	16	185
L cuboid	-	59	61	11	18	13	14	176
L medial cuneiform	-	55	52	11	21	16	17	172
L intermediate cuneiform	-	51	39	9	15	13	13	140
L lateral cuneiform	-	43	40	12	16	14	9	134
R calcaneus	-	62	72	19	20	14	22	209
R talus	-	61	73	15	21	25	21	216
R navicular	-	55	59	15	16	17	17	179
R cuboid	-	51	58	12	17	10	17	165
R medial cuneiform	-	54	52	11	17	14	17	165
R intermediate cuneiform	-	49	42	8	13	13	14	139
R lateral cuneiform	-	46	50	10	16	12	16	150
R ribs	-	1054	775	185	275	166	251	2706
L ribs	-	1063	790	183	272	192	260	2760
Unsided ribs	-	0	2	0	12	8	2	24
Cervical vertebrae	Whole	653	504	113	161	99	118	1648
	Body only	6	3	6	4	27	6	52
	Neural arch only	0	6	0	1	8	12	27

Thoracic vertebrae	Whole	1245	813	200	285	115	273	2931
	Body only	36	34	15	14	85	11	195
	Neural arch only	1	24	4	11	15	11	66
Lumbar vertebrae	Whole	515	356	91	117	60	117	1256
	Body only	6	4	6	1	25	0	42
	Neural arch only	8	13	9	13	13	8	64
Sacral segment 1	Whole	97	76	18	26	19	24	260
	Body only	0	0	0	0	4	0	4
	Neural arch only	4	0	1	0	1	0	6

APPENDIX E – Hospital Admission Data for Possible Injury Recidivists

Table E.1 Hospital admission data for possible injury recidivism

Name	Element	Admission Date	Discharge Date
St. Thomas'			
William White	knee pan	21 August 1788	21 May 1789
	leg	16 July 1789	3 December 1789
Evan Davis	arm	4 December 1794	22 January 1795
	clavicle	26 March 1795	14 May 1795
Guy's			
Jane Ebsworth	[fractured]	17 November 1815	7 February 1816
	knee	24 February 1816	5 June 1816
Thomas Nicholson	clavicle	23 December 1816	19 February 1817
	arm	4 July 1817	13 August 1817
John Jones	leg	23 September 1815	21 February 1816
	clavicle	4 August 1818	26 August 1818
	arm	26 December 1819	12 April 1820
	thigh	5 June 1820	25 October 1820
Mary Short	arm	10 July 1818	No date
	arm	20 September 1820	15 November 1820
	leg	3 May 1822	24 July 1822
Cornelius Collins	clavicle	11 May 1819	No date
	arm	28 June 1822	17 July 1822
	leg	2 July 1836	5 October 1836
James Topham	arm	22 March 1817	2 July 1817
	thigh	28 October 1822	15 January 1823
	patella	1 February 1831	11 May 1831
Susannah Brown	arm	27 November 1822	25 December 1822
	[fractures]	16 January 1823	No discharge date
John Sullivan	clavicle	26 May 1824	16 June 1824
	zygomatic	21 June 1824	23 June 1824
Mary White	leg	13 January 1822	17 July 1822
	clavicle	8 June 1824	7 July 1824
James Brown	ribs	4 July 1825	13 July 1825
	compound cranium	3 July 1828	9 July 1828
	arm	20 May 1833	7 August 1833
	leg	28 July 1834	3 September 1834
	ribs	26 April 1836	18 May 1836
	thigh	3 September 1837	11 July 1838
Thomas Moore	leg	13 May 1820	No date
	ribs	6 November 1827	14 November 1827

	thigh	24 August 1828	17 September 1828
William Leonard	rib	25 October 1826	22 November 1826
	leg	6 April 1830	14 July 1830
Mary Harrison	thigh	17 April 1816	21 May 1816
	leg	4 July 1831	13 July 1831
	cranium	24 September 1831	12 October 1831
Daniel Sullivan	arm	25 May 1827	6 June 1827
	thigh	17 December 1829	27 January 1830
	leg	29 May 1833	5 June 1833
	thigh	13 April 1834	30 July 1834
	arm	17 July 1837	26 July 1837
Dennis Sullivan	leg	25 May 1832	15 August 1832
	arm	27 March 1835	22 April 1835
Thomas Evans	leg	6 December 1823	31 December 1823
	rib	17 December 1827	2 January 1828
	cranium	4 April 1834	No date
	ribs	2 April 1835	15 April 1835
	leg	10 April 1837	14 May 1837
William Taylor	leg	21 July 1827	29 August 1827
	arm	2 March 1830	7 April 1830
	leg	15 July 1833	21 August 1833
	clavicle	22 October 1835	9 December 1835
Thomas King	leg	25 December 1827	19 March 1828
	cranium	14 December 1837	20 June 1838
	leg	24 January 1838	No date

APPENDIX F – Rank of Fractured Elements in Skeletal Dataset

Table F.1 Rank of fractured elements in total skeletal dataset by sex

Element	Males		Females		
	Total # of fractured elements	**Rank**	**Element**	**Total # of fractured elements**	**Rank**
Ribs	339	1	Ribs	127	1
Nasal	53	2	Radius	18	2
Metacarpal 1	26	3	Thoracic vertebra	7	3
Fibula	25	4	Ulna	6	4
Thoracic vertebra	24	5	Navicular	5	5
Proximal manual phalanx	15	6	Proximal manual phalanx	5	5
Tibia	14	7	Tibia	4	6
Radius	12	8	Fibula	4	6
Femur	11	9	Patella	3	7
Metacarpal 5	10	10	Metacarpal 1	3	7
Distal pedal phalanx	10	10	Metacarpal 5	3	7
Humerus	8	11	Distal manual phalanx	3	7
Patella	7	12	Lumbar vertebra	3	7
Metacarpal 3	7	12	Humerus	2	8
Calcaneus	7	12	Nasal	2	8
Clavicle	6	13	Hamate	2	8
Metatarsal 5	6	13	Calcaneus	2	8
Ilium	5	14	Cervical vertebra	2	8
Intermediate manual phalanx	5	14	Femur	1	9
Metatarsal 2	5	14	Clavicle	1	9
Talus	5	14	Scapula	1	9
Ulna	4	15	Metacarpal 2	1	9
Metatarsal 1	4	15	Metacarpal 3	1	9
Metatarsal 3	4	15	Metacarpal 4	1	9
Sternum	3	16	Ilium	0	
Metacarpal 2	3	16	Sternum	0	
Trapezium	3	16	Mandible	0	

Metatarsal 4	3	16	Maxilla	0	
Proximal pedal phalanx	3	16	Zygomatic	0	
Zygomatic	2	17	Scaphoid	0	
Scapula	2	17	Trapezium	0	
Metacarpal 4	2	17	Intermediate manual phalanx	0	
Cervical vertebra	2	17	Metatarsal 1	0	
Mandible	1	18	Metatarsal 2	0	
Maxilla	1	18	Metatarsal 3	0	
Scaphoid	1	18	Metatarsal 4	0	
Distal manual phalanx	1	18	Metatarsal 5	0	
Cuboid	1	18	Talus	0	
Medial cuneiform	1	18	Cuboid	0	
Lumbar vertebra	1	18	Med cuneiform	0	
Sacrum	1	18	Proximal pedal phalanx	0	
Hamate	0	-	Distal pedal phalanx	0	
Navicular	0	-	Sacrum	0	