Interpersonal violence and fracture patterns in 18th- and 19th-century London

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Abstract

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Violent behaviour can be seen all over the world and across time; it is also intrinsically linked to culture. As such, the analysis of skeletal material presents excellent physical evidence of violent occurrences within communities. The current thesis looks to understand the possible presence of fracture patterns and interpersonal violence in London during the 18th and 19th centuries by analysing the fracture patterns observed on six skeletal collections from the geographical area and characterised by various social and economic contexts. The contextualisation of each burial ground proved to be imperative to the research. The statistical results revealed that grouping collections together based on their socioeconomic status does not describe nor explain the fracture patterns seen in the collections considering that some did not emulate the characterisation implemented upon them by the media or City officials at the time. It also was found that the patrilineal society and the subsequent sexual division of labour had a profound effect on the results especially when comparing the prevalence of fractures between men and women. Therefore, this thesis provides a comprehensive overview of fracture patterns and the presence of interpersonal violence in regards to the different lifestyles and socioeconomic contexts found in London during the 18th and 19th centuries and how such behaviour affected the individuals' daily lives.

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Chapter 1
Introduction

> "[Violence is] a phenomenon in the eye of the beholder, a historically defined notion dependent not only on physically aggressive acts but also views of justice, attitudes towards cruelty and notions of public and private space, among other things. The boundaries between legitimate and illegitimate forms of physical aggression, a fundamental distinction, are established and maintained culturally."
>
> (Wood 2007: 85)

Throughout humankind's existence, violence has been an inescapable phenomenon that can be found all over the world. The World Health Organization (2012a) describes violence as "the intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community". Whilst some individuals reside in areas where active warfare is part of their daily lives, those lucky enough not to have first-hand knowledge of the atrocities of war will undoubtedly recognise the fact that violence in its other forms does ultimately take place in all other areas of the world. As a term, violence also encompasses actions that are not armed and are found much closer to home, such as domestic violence and bullying; therefore, these actions can include both physical and non-physical violence, such as psychological attacks and deprivation (World Health Organization 2011).

Presently, upwards of 1.5 million people worldwide lose their lives as a direct result of a violent act every year (World Health Organization 2012b). Additionally, in October of 2002, the World Health Organization launched the first global report on violence and health. Violence was found to be the leading cause of death for individuals between the ages of 15 and 44 years and accounted for approximately 14% of male deaths, as well as half that percentage for female deaths (World Health Organization 2002). Most recently, violence is regarded as a public health issue where public policies, based on the information published in the report, are created and instilled with the goal of preventing its occurrence in every form (World Health Organization 2002). Evidently, an excessive number of individuals lose their lives at the hands of another human being or are affected by violent behaviour in one form or another; however, according to Pinker (2011: xxi), the world has currently reached an era where humankind's interactions are at their most peaceful and where violent occurrences were much more prevalent and much worse in the past than they are today.

1.1 CULTURE, SOCIETY AND VIOLENCE

While the current study aims to explore the presence of interpersonal violence in London during the 18th and 19th centuries, it is important to understand the concepts of culture and society and how they influence human interactions and consequently, violence. As a result, this section looks to clarify those concepts prior to focusing the research on interpersonal violence, rather than violence related to war, and its possible presence in 18th- and 19th-century London.

1.1.1 The concept of culture

The concept of culture has held a number of descriptions in the past serving to explain its relevance and importance to humankind; however, the definition of the concept attributed to Britain's Edward Burnett Tylor, one of two main founders of anthropology, has been traditionally used by many in anthropology. He defined culture as a "complex whole of knowledge, beliefs, art, morals, law, customs as well as any capabilities and habits acquired by man as a member of society." (Izard 2004: 190; White 1959: 227, both citing E. B. Tylor's (1871) opening lines of *Primitive Culture: Researches in the Development of Mythology, Philosophy, Religion, Language Art and Custom*).

Consequently, culture is a distinct attribute as well as a universal characteristic that is fundamental in the collective human condition (Izard 2004); however, no culture is isolated and endogenous developments are not caused by cultural dynamics but rather by permanent interactions between cultures (Izard 2004: 190). Nonetheless, every culture is inclined to assert its independence by underlining its divergence, thought to be irreducible, from the other cultures with which it is in contact (Izard 2004: 192).

1.1.1.1 Culture determines behaviour

It is important to remember that culture and behaviour are not conceptually identical. White (1959: 234, 247) redefined the concept of culture as "a class of things and events, dependent upon symboling, considered in an extrasomatic context." so that it now becomes "a real, substantial, observable subject matter" (White 1959: 234) where the distinction between culture and behaviour is sharply discernible.

As a set of shared meanings, which survives by being learned and transferred from one generation to the next, culture is a prominent determinant of human behaviour in all societies. It serves as an explanation regarding the acceptable manner in which people must interact with the world and with each other; it also gives its people a profound sense of identity. Not only does culture affect people's ideas but it will also affect their mannerisms (Galaty and Leavitt 2004: 193; Wood 2007: 81) as it is also a method used by individuals to adapt to new changes as well as being a survival strategy (Roberts and Cox 2003: 13). In other words, an individual's behaviour is a response to or a function of their respective culture and it will vary in direct correlation to the changes seen in culture (White 1959: 241).

1.1.2 The concept of society

Every individual is born within a pre-existing society, where they will learn and acquire its corresponding culture (Leach 2004: 668). Society can be described as being a discrete system, that is susceptible to the rule of a hierarchal perspective, which evolves from a primitive, to an archaic, to then a modern state (Leach 2004: 668, citing T. Parsons' (1966) *Societies: Evolutionary and Comparative Perspectives*). It is also defined as a group of human beings provided its existence is based on its auto-reproductive capabilities resulting from a set of rules, where the group's or society's life expectancy exceeds that of each individual involved (Aberle et al. 1950; Leach 2004: 688).

Just like individual cultures are influenced by other cultures, societies are not impenetrable entities and they will be subjected to exchanges that traverse cultural barriers (Leach 2004: 668-669). Consequently, a society must be able to adapt in concordance to events that threaten its survival (Aberle et al. 1950: 104). Furthermore, one society does not equal one culture. Not only can multiple societies share the same culture, one society can present groups that have different cultural identifications (Aberle et al. 1950: 102).

A society will provide for its members; yet, can do so discriminatorily as it needs certain members to fill certain roles such as adults for reproduction and to fill mandatory status-positions (Aberle et al. 1950: 104). This will also lead to role differentiation based on age and sex, which takes place everywhere, as well as based on class and occupation (Aberle et al. 1950: 105). These social segregations will be seen over the course of this thesis due to the nature of London society during the eighteenth and nineteenth centuries.

1.1.3 Understanding violent behaviour

The relationship between the physical and cultural aspects of life is interconnected when observing the presence of violence within a community or population (Brickley and Smith 2006; Carroll 2007; Pinker 2011; Wood 2007). Violence is a behaviour that is culturally and socially linked to humankind which can produce physical effects, such as substantially injuring an individual where permanent evidence of its occurrence may emerge on the victim's bodily tissues, including bones. Such evidence can remain detectable long after the initial injury occurred. The physical effects of violence are evidently correlated with culture in view of the fact that the exhibited violent behaviour, and subsequent injuries, are influenced by the accepted norms of the culture in which the violent incident occurred.

The concept of violence will fluctuate chronologically and geographically (Guilaine and Zammit 2001: 319) since accepted forms of violence are not isolated to specific geographical areas or certain cultures nor are they limited to certain aspects of culture. For example, violence is often prominently featured in the foundation myths affirmed by many different faiths, where some gods, violent beings themselves, need auspicious blood sacrifices in order to be conciliated (Carroll 2007: 1-2). Within the pages of scriptures, instances of torture, rape and murder at the hands of a stranger, a loved one or a ruler will be found and oftentimes those acts of violence are instigated by the aggressor's deity. Pinker (2011: 6) states that "for all this reverence, the Bible is one long celebration of violence." Furthermore, not only has violence been celebrated in the past, it has also been used, then as well as now, for justification to commit atrocities in the name of one's deity such as The Crusades in the name of Christ and jihads in the name of Allah, for example. Consequently, the knowledge, beliefs, morals, and art of a culture are examples of aspects that can be affected by violence. Evidently, the affected facets of culture will also vary based on the circumstances that promulgated the use of violence.

Violence was and still is presently and widely used as a way to assert one's dominance and superiority over another individual deemed inferior and wanting them to conform to a different ideal (Amussen 1995: 27; Pinker 2011). It is clear that violent actions are unlikely to be removed from the behavioural characteristics of humankind in the foreseeable future; and, that violence is rooted into something deeper than simply quantifying it as a type of behaviour that can be eradicated from our essence.

1.1.3.1 The violence triangle and its participants

When violence occurs, there are up to three participants: the aggressor, the victim and the bystander (Pinker 2011: 35). Each of these participants will have a motive for such behaviour which is explained and illustrated below in Figure 1.1. Predation is the main motive for attacking a victim; on the other hand, as a response to being preyed upon, the victim will retaliate accordingly. The bystander, rather than being directly involved in the incident, is used as a method to limit the non-partisan casualties from the fight and make sure the fight itself does not reach unacceptable levels (Pinker 2011: 35), which are of course outlined by the relevant cultural norms.

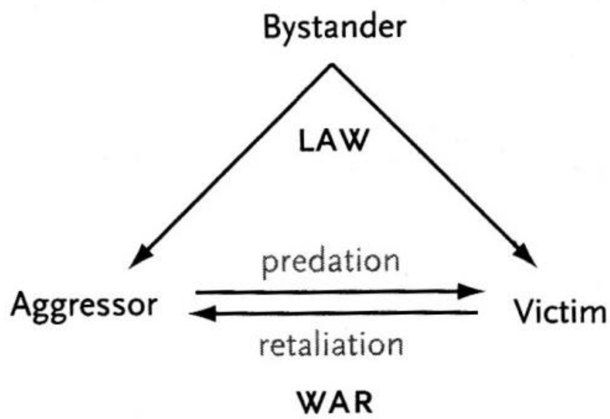


Figure 1.1 - The violence triangle. From Pinker (2011: 35).

When looking at Figure 1.1, the term war does not necessarily refer to warfare as the term is currently used. While predation and retaliation between an aggressor and victim can certainly lead to war, in this case, it can also refer to incidents of interpersonal violence. Two individuals can engage in a violent interaction without the consequence resulting in armed combat involving two or more groups or nations. As a result, this triangle explains how the various violent interactions are either classified as being an act of war, or alternatively an incident of interpersonal violence, or on the other hand, classified as an act of law. Acts of law, while they can be as simple as an actual person interrupting a fight between two individuals, they can also be manifested as a mentality or attitude that limits or shuns certain acts of violence, such as the culturally determined rules and regulations for a fair fight.

1.1.3.2 The incentives for violence

The triangle (Figure 1.1) offers perspective on the various participants involved in acts of violence as well as their motives behind the behaviour. The incentives associated with the display of such behaviour between the aggressor and victim can be further broken down into three principal causes that offer insight into the concepts of predation and retaliation manifested by those involved. These three causes are: (1) competition, (2) diffidence or fear, and (3) honour. The first recognises that violence is used in order to assert one's dominance over another individual, or even over animals such as cattle, while the second is used to defend what has been amassed as a direct result of the competition. These incentives perfectly describe reasons for an aggressor to prey on its victim where the former either desires something the latter possesses or for fear of retaliation at the hands of the victim, may pre-emptively attack. Finally, the third and final cause of violence, honour, will be a recurring theme within this thesis and encompasses any action that is a direct result of having one's reputation, or their kin's reputations, tarnished or undervalued (Pinker 2011: 33, citing Thomas Hobbes's (1651) *Leviathan*). The bystander, whether taking the form of a person or attitude, will nonetheless retain their role, which enforces the line of acceptability, so that the acts of violence do not get out of hand. As a result, the triangle of violence, which melds together the three participants as well as the three principal causes of violence, allows for a better demonstration and understanding of the reasons for the presence of violent behaviour throughout the world's cultures.

1.1.3.3 The narrative of violence

Not only do violent acts have participants and general incentives, the acts also have a strong cultural meaning behind them (Robb 1997: 111) and those cultural meanings will characterise whether the acts of violence fall either in the law or war category. While culture will add meaning to the violent behaviour, it will also provide a narrative which will allow individuals to understand those implications. This chronicle is provided by the actors involved at the time which includes individuals from the general population, the media and the judicial system; also, its formulation is used to justify the presence and sanction, or alternatively the shunning, of violent acts within the community (Wood 2007: 82). As a result, culture will play a part in shaping the presence of violence and the type of violence seen in a population. This is done by categorising certain acts and behaviours as socially acceptable, or even useful in some cases, while others are strictly prohibited (Amussen 1994; Amussen 1995; Beattie 1986; Clark 1992; Doggett 1992; Guilaine and Zammit 2001; Hurl-Eamon 2005; Judd 2004; Pinker 2011; Shoemaker 2001, 2004; Wood 2004; Wood 2007).

1.1.3.4 Violence's chronological and geographical evolution

Not only is violence a universal phenomenon, it is also trans-historical (Guilaine and Zammit 2001; Wiener 2004: 10). Violence is certainly not a new phenomenon; it is just as present in the distant past as it is in the present. The presence of violence in the past is clearly evident thanks to the physical manifestations and resultant objects which are discernible indicators that it very much affected the lives of previous populations. This common human characteristic is represented in the existence of fortifications, settlement sites that are easily defendable, various types of weaponry that can be easily accessible, iconographical and symbolic exemplifications of such physical expressions of war, as well as visible signs of trauma found on skeletal material (Guilaine and Zammit 2001; Larsen 1997: 119).

This perfectly underscores the fact that violence, both its manifestation and meaning, just like languages and ideas, evolve over time and fluctuate continuously, similarly to the evolution undertaken by its corresponding society and culture. Duelling is an excellent example of the meaning and acceptability of violence changing over the course of time. When first introduced during the Renaissance, duelling was an acceptable form of violence due to being characterised as a method to reduce worse and larger incidents of interpersonal violence and confine the number of victims. However, as attitudes towards public displays of violence changed over time, it became more and more intolerable during the 18th century (Pinker 2011: 22; Shoemaker 2001, 2004; Stone 1983: 29-30) and it would be unimaginable today. Another example of that tangible change of attitude over time can be seen in the acceptability and legality of corporal and capital punishment. In the past, punishment for an infraction at the hands of the state would habitually involve a form of torture or, in some cases, execution. Such severe and brutal punishments were used as a method to discourage the general public of committing such infractions by terrorising them into submission (Pinker 2011: 144-145). In today's world, the legal and sanctioned administration of capital punishment for certain convictions remains an acceptable form of punishment. However, this condemnation is certainly not legal in every country or state; and, the countries or states that do accept the legality of such a punishment will not necessarily condemn an individual to such a fate for the same offences as another.

As a result, it is clear that certain behaviours are not universally acceptable and culture has a major effect on that characterisation. Violence and its limits will continuously transform based on, and in correlation to, the corresponding evolutionary process concerning acceptable behaviour of the culture and society in which it is manifested.

1.2 INTERPERSONAL VIOLENCE AS OPPOSED TO WARFARE

This section explores the distinctions between armed combat and incidents of interpersonal violence. Such a characterisation will offer a more comprehensive preliminary explanation behind the emphasis on studying incidents of interpersonal violence in London during the 18th- and 19th-centuries. The World Health Organization (2002) categorises violence into three separate processes: (1) self-directed, (2) interpersonal and (3) collective violence. Armed conflicts, human right violations and organised crime fall under the 'collective violence' category and as a result will not be included in the focus of this thesis. The violent behaviour and resultant injuries that are seen between family members and members of the same community, or in other words, interpersonal violence (World Health Organization 2002, 2011), is of interest and is the nucleus of the current thesis.

When looking at the past, the presence of interpersonal violence can be associated with various social and economic situations, such as: sedentary life; competition over resources and mates; intricate and unequal social situations; and enhanced trade and contact possibilities (Roberts 2000: 338), which can all be categorised as the 'competition' incentive for violence seen in section 1.1.1. Subsequently, it can very well be the resulting action when an individual deems that their needs, such as sustenance, security and status, are not met (Wood

2007: 84) which encompasses the incentive of 'diffidence or fear'. Finally, interpersonal violence is indistinguishably connected to identity, behaviour, hierarchy, development, recreation and other social concerns found within a specific community (Wood 2004: 15) which tend to revolve around one's sense of honour and glory. As a result, the presence of interpersonal violence is inextricably linked with the needs of individuals and with the changes to those needs brought on by extrinsic pressures. Subsequently, the levels of interpersonal violence have been known to increase with such changes, especially to the residential environment and access to sustenance, usually caused by a sudden demographic growth (Larsen 1997: 155-156; Papathanasiou et al. 2000: 225; Torres-Rouff and Junqueira 2006: 61; Van Der Merwe et al. 2009: 13).

Not only will the meaning of violence vary among different populations, it will also vary among individuals belonging to the same population (Alhabib et al. 2010: 373; Walker 2001: 575; Wood 2004: 2). The aforementioned cultural and social relationships will also undoubtedly play a role in determining the balance of power found between the individuals belonging to a population (Robb 1997: 111). Defining that balance is done in accordance with the attitudes held by the general public regarding violence. This attitude will govern and mediate other social issues, such as structures of authority, gender equality, and behavioural standards, in addition to formulating the balance of power (Aberle et al. 1950; Wood 2004). This will inevitably affect individuals differently based on gender and socioeconomic status, among other criteria, which can in turn produce differing outlooks towards the presence and acceptability of violence in one population.

1.2.1 Limiting acts of interpersonal violence

Consequently, rooted within the social and cultural contexts of a civilization, there are rules that govern violent interactions between individuals and between groups (Amussen 1994; Carroll 2007; Judd 2004: 47; Pinker 2011; Robb 1997; Wiener 2004: 10). There are limits to how severely an individual can inflict violent injuries on another, especially in the case of ritualised fighting. For example, the use of projectiles, and the resultant piercing injuries that customarily exist within the context of warfare between unrelated groups (Lambert 1997; Scott and Buckley 2010: 515), is usually less likely in instances of intra-community violence due to the very real possibility of fatally injuring the opponent. For example, in many cases, the objective of ritualized fights within a community is not to kill one's opponent, only cause injury, (Walker 1989: 319) as that would transform the violence into an unacceptable occurrence and it would be punishable by law. Fatal injuries were not the objective when settling disputes within the community as it would be detrimental to its protection and proper functioning (Scott and Buckley 2010: 515).

These limits were instated by a cultural understanding of what is considered to be a fair and honourable fight (Shoemaker 2004). From these limits were established a set of clear rules which served to legitimise the interpersonal violence within the community and dictate the appropriate time and place it could occur (Amussen 1994: 82; Carroll 2007: 12; Shoemaker 2004: 153). Oftentimes, as will be seen in the history of violence in London during the eighteenth and nineteenth centuries, fist fighting became the acceptable manifestation of public violence used to settle disputes as the chances of delivering a fatal blow were reduced and bystanders could intervene prior to the fight reaching unacceptable levels. Habitually, these arguments and subsequent fights between individuals from the same population were not a random occurrence (Amussen 1994: 75), they customarily would be the result of the most trivial of offences such as bumping into someone on the street (Gray 2007: 78). But this does dictate that violence was a legitimate reaction when one felt that they had been violated or offended by another individual.

1.3 Thesis organization

John Carter Wood (2004: 3), a crime historian, states that violence does not have a consistent unit of measure which can be applied to explain the relevance of violence in cultures over a period of time. Evidently, this statement is supported by the information mentioned above regarding the evolution of attitudes towards violence over a period of time and how those attitudes are in a continuous state of fluctuation, both geographically and chronologically. However, human skeletal remains do offer a form of primary evidence which can demonstrate the possible presence of violence in communities from the past. While the use of skeletal material can be very dependent on its degree of preservation and cannot explain the relevance of violence within a specific culture on its own, it is certainly a material available for study which can serve to explain the prevalence of violence in a particular community. Subsequently, the use of skeletal material in order to observe the possible presence of interpersonal violence in 18th- and 19th-century London is at the core of this thesis. The current section gives a brief overview of the organisation of the current study by briefly summarising the contents seen in each of the subsequent chapters.

1.3.1 Background information

Chapter 2 explores a range of literary sources in order to develop a context for the current project. This informational base serves to determine how the research should be conducted and defines the intention behind this project.

1.3.1.1 Bioarchaeology

This section will explore the discipline of bioarchaeology and its fundamental goals. There are limitations that can arise and impeded those when studying skeletal remains and such issues will be discussed. Lastly, the methods behind this type of study have also transformed as the discipline was developed and that progression will be presented.

1.3.1.2 Fractures

The chapter will continue by providing a description on the subject of fractures. This section will comprise of such topics as: the biomechanics of bone and fractures, the types of fractures that can occur, the healing process, the identification of fractures on bone, their aetiology and subsequently, the possible skeletal markers of interpersonal violence.

1.3.1.3 Historical sources

A historical overview is presented in the section in order to obtain a clearer picture of life in London during the eighteenth and nineteenth centuries which will evidently help to understand the fracture patterns seen on the skeletal material. A general overview of life in London is portrayed prior to exploring topics such as: the differences in lifestyles between the wealthier and poorer inhabitants and the gender standards, which shaped an individual's level of participation in the public or private spheres of London society. Finally, violence in London is explored in order to determine who committed such acts as well as how violence was viewed by Londoners according to the historical accounts.

1.3.2 Research aims, materials and methods

1.3.2.1 Aims, objectives and hypotheses

The preliminary section of Chapter 3 focuses on the different research aims and objectives as well as the resulting research questions that will form the basis of the current study. These questions are then associated with various hypotheses, which were established with the information gathered in Chapter 2. Skeletal material, as a source of primary physical evidence for the possible presence of violence, is perfectly suited to answer these hypotheses.

1.3.2.2 Materials

The next section of Chapter 3 begins by describing each of the skeletal collections that were utilised for this project. Information retrieved from historical archives as well as information revealed during the archaeological excavations will be given for each burial ground. Following this, the section explores the specific limitations encountered when analysing the skeletal material as well as the degree of preservation observed for each collection. The database utilised during the data collection process, including a description of the program that was used to collect the data, is also presented.

1.3.2.3 Methods

Chapter 3 also explores the methods used to analyse the skeletal material. The methods for determining the biological profile, which involves determining the age at death and sex of each skeleton, the characteristics used to determine the presence of healed fractures on the skeletal material and the anatomical categorisation of fractures used in the statistical analysis are all described in this section of the chapter.

1.3.2.4 Statistical analysis

The last sub-section of Chapter 3 explores the statistical application of the data analysis which will produce the results and essentially build and formulate the heart of the current study. Each statistical calculation used over the course of this study is identified and presented, as well as guidelines for the interpretation of the results. On the other hand, there are some problems that arose with the use of certain statistical tests and these limitations, as well as their solutions, will also be mentioned in this sub-section.

1.3.3 Results

1.3.3.1 Three Results chapters

The results are presented in three separate chapters where a general overview of the subject matter becomes narrower to focus on specific fracture types as the Results chapters progress. This was done in order to have a clear and concise organisation of the large amount of information and as such, develop a clearer understanding of what the results truly reveal.

Chapter 4, the preliminary Results chapter, focuses on the fractures seen in the collective sample, which proposes that all the fractures seen on the analysed individuals regardless of their location on the skeleton are observed. By proceeding in this manner, it is possible to discern which collection has more or fewer fractures than the others and how the social and economic context may have affected the outcome. Once this general overview of the presence of fractures has been achieved, Chapter 5 categorises the fractures according to their anatomical location on the skeletons. This classification begins to uncover possible fracture patterns in the skeletal collections and the likelihood that some anatomical areas could exhibit more fractures than others. Finally, Chapter 6 explores the five fracture types that have been identified as possible markers for interpersonal violence.

1.3.3.2 Results chapters sub-divisions

Each of the three Results chapters described above follow the same pattern in order to concisely organise and present the obtained results. The first section looks at the whole sample regardless of age or sex. The results are then presented for each sex as well as each age category presented in Chapter 3. Finally, the sexes and the age categories are cross-compared separately.

Within each of the sections related to sex and age, three additional divisions are made according to the types of statistical tests that were performed on the data. Once again, they all follow the same pattern in each Results chapter as well as in each of the sub-division. Firstly, the prevalence rates are explored in order to get an idea of which collection suffered more fractures according to the age or sex and according to the fracture type. The second round of statistical tests involves presenting the results obtained from the Chi-square test. Finally, the last statistical method presented in each sub-section involves revealing the odds ratios and their standardisation.

Now that the results have been presented, they must be analysed in order to be able to interpret them and obtain a conclusion regarding the research questions and the hypotheses laid out in Chapter 3.

1.3.4 Discussion

The obtained results divulge a large amount of very useful information; however, in order to truly understand what they are trying to convey, they must be interpreted, which is achieved by combining the acquired results with the information gathered from historical and clinical accounts. A discussion chapter serves to highlight the results that are the most thought-provoking and those that strengthen recurring themes found within the results. Rather than follow the structure and divisions seen in the three Results chapters, Chapter 7 is formulated based on the hypotheses presented in Chapter 3.

Summary

Violence is a universally present phenomenon that is manifested in every culture and society according to a set of rules which governs its degrees of acceptability. Throughout history, violence has been present in human interactions and is still very much a part of many people's daily lives in the present world we live in. However, the world has seen an evolution in regards to the acceptability of violent behaviour which will vary according to a particular situation or a particular area of the world. One thing remains constant throughout the change in attitudes towards violence, an individual will resort to violent behaviour when the gains of such displays will outweigh the encumbering costs (Pinker 2011: 33). This clearly indicates that violence is deeply rooted in the cultural context of any society or population and that culture will govern the levels of acceptable violent behaviour.

Violence is a topic that is very broad and encompasses many different aspects, situations and results; therefore, a more specific and focused topic is necessary in order to have a clear and concise thesis. Intrinsically, fractures resulting from incidences of interpersonal violence rather than warfare were chosen based on the cultural understanding that violence to assert one's dominance and status or to resolve disputes is not intended to end by taking the life of another individual. Since this thesis is looking at the presence of interpersonal violence in London during the eighteenth and nineteenth centuries, the presence of healed or healing fractures is instrumental in being able to obtain that information from the selected and available skeletal material. Furthermore, warfare is habitually found between groups while interpersonal violence is more centrally focused on the individual. Exploring the presence of interpersonal violence permits the study to delve deeper into the connections shared amongst individuals who interacted on a daily basis. As a result, it becomes possible to begin to understand the way people lived their lives in London during the eighteenth and nineteenth centuries.

Chapter 2
Background Research

> Human skeletal remains, […], provide direct evidence of interpersonal violence in both prehistoric and historically documented societies that, in many respects, is immune to the interpretive difficulties posed by literary sources.
>
> (Walker, 2001: 574)

In this chapter, an overview of the discipline of bioarchaeology is presented in order to understand the foundation, goals and methods that these types of studies will aim to achieve and utilise. Following this, a section will focus on fractures which will present the biomechanics and the various types of fractures that can occur according to different variables. This section will also explore the healing process that takes place when a bone is fractured and how such lesions are identified on the skeletal material. The aetiology or causes of fractures is observed which leads to identifying, based on the review of the literature, five fracture types that are more commonly associated with interpersonal violence. These fracture types are the basis for determining the possible presence, as well as the prevalence rate, of incidents of interpersonal violence found within London during the eighteenth and nineteenth centuries.

In order to contextualise the analysed skeletal material, a general overview of life in London will be explored which will detail the numerous changes seen during the eighteenth and nineteenth centuries in the City and its surrounding boroughs. Furthermore, there will be an emphasis on the differences seen between the lifestyles of the wealthy and the poor as well as the daily activities of men and women and how those roles affected the various communities' well-being and experiences seen in London during that time period. Finally, this is followed by a discussion regarding Londoners' attitude towards violence during the eighteenth and nineteenth centuries.

2.1 BIOARCHAEOLOGY

Many disciplines, such as sociology, history and psychology, for example, undertake studies which focus on the presence of violence within as well as between populations. According to Walker (2001: 574), historical and ethnographic sources only offer a limited point of view regarding humankind's capacity for violence as they do not encompass the vast number of societies that are now extinct with no associated written accounts of their way of life. Furthermore, he also states that cultural biases do have an effect on the historical description of violence and that some believe the observer's prejudices will obscure the true state of this behaviour, as it is highly entrenched in the political and emotional aspects of culture. Rather than emphasising the subject's reality, historical sources can be much more representative of the values and morals of the historian (Larsen 2002: 144). As such, bioarchaeological studies offer a different option when studying past populations and its emphasis lies in uncovering the biological consideration of archaeology (Larsen 1997: 2).

2.1.1 Foundation

The foundation of bioarchaeology lies within the field of human osteology which invokes the study of human skeletal remains (Larsen 2002: 119). Skeletal material is a type of primary physical evidence as it is possible to examine human remains and determine a breadth of information regarding an array of factors that can affect past populations, such as: health, diet, lifestyle, behaviour, ancestry, trauma, etc. (Larsen 1997: 2; 2002: 119; Roberts and Cox 2003: 13) The hard tissues found in the human body, the bones and the teeth, are capable of preserving a great amount of biological information that is relevant to the study of the past (Larsen 1997: 2). As a result, it is possible to examine this unique source material and subsequently study the biological factors affecting people of the past.

Since skeletonised human remains are the sole undeniable record of violence, bioarchaeology is indispensable when forming a historical account of such behaviour. It provides the literature with a better understanding of the perpetrators' and victims' social identities as well as the causes and outcomes of aggressive behaviour towards another individual or group as skeletal records are not encumbered by interpretative biases (Larsen 2012).

2.1.2 Goals

When undertaking a bioarchaeological study, the research aims to meld the information retrieved from the skeletal material with its corresponding context. As a result, the researcher explores the associated environmental, cultural and social circumstances which affected the population under study and aspires to determine how those factors influenced the differences or similarities that are observed on the skeletal material (Tung 2007: 954). By including information from different sources, determining the actuality of events becomes gradually greater (Walker 2001: 579) and the possibility of interpretive error is reduced (Larsen 2002: 144). Consequently, bioarchaeology studies allow for a better understanding and a more knowledgeable perspective of the day-to-day interactions of past populations to be progressively attained (Larsen 1997: 334; Walker 2001: 575). Ultimately, bioarchaeology strives to obtain results and interpretations regarding past populations that have implications towards the lives of present populations (Harrod et al. 2012: 279).

2.1.3 Limitations

Human skeletal remains are a very useful source of research material that can yield vast amounts of information; nevertheless, it is not irreproachable. There are issues that arise when undertaking the bioarchaeological study of skeletal samples (Larsen 1997; Wood et al. 1992; Wright and Yoder 2003: 45).

2.1.3.1 Sample representation

Skeletal material retrieved archaeologically is representative of a biased sample of the population due to the fact that cemeteries contain multiple generations of individuals rather than strictly biological populations (Larsen 1997: 334). In view of the fact that the material under study is the remains of deceased individuals, the direct relevance of the lesions presented by the skeletal sample is not reflective of their presence in the living population; individuals will have different experiences that will lead to death, which inevitably transpires at different times and is the result of various causes (Larsen 1997: 334; Wood et al. 1992; Wright and Yoder 2003: 45). The extent to which an individual is susceptible to experiences causing death will greatly vary from person to person. Nonetheless, Larsen (1997: 339) is adamant when expressing the notion that archaeological skeletal material is representative of its corresponding population even with the nearly universal presence of biological and selective biases.

2.1.3.2 Preservation

The degree of preservation of the skeletal material shapes the scope for the study of skeletal human remains and it is dependent on many factors (i.e. physical, chemical and biological elements) that are intrinsic (i.e. shape, size, age and health of the bones) and extrinsic (i.e. environment, animals and humans) (Henderson 1987: 43-45). Furthermore, it is important to remember of that burial rites vary according to culture and society and the burial methods (i.e. cremation or inhumation, type of coffin, use of a vault, etc.) utilised to dispose of the remains will influence their preservation (Roberts and Cox 2003: 13).

The prospect of carrying out age estimations and determining sex is dependent on the preservation of the remains as it is quite possible that the bones used to determine age and sex are either missing from the skeletal inventory, or that they have been damaged to the degree where sexing and aging is not feasible. If the skeleton is not well preserved, it is also very likely that it can obstruct or obliterate signs of a healed or healing fracture (Henderson 1987). It can also become problematic to discern peri-mortem fractures from post-mortem fractures (for a description of peri-mortem and post-mortem fractures, see below in sections 2.2.4.2 and 2.2.4.3, respectively) unless the skeletal material presents excellent preservation (Jurmain 1998: 185). Consequently, preservation within a skeletal population must be taken into account as skeletons will not suffer from or react to the same taphonomical events as others, even when from the same burial ground (Henderson 1987).

2.1.3.3 Soft-tissue injuries

Another issue presents itself when observing the presence of violence in past populations with regard to the amount and types of injuries an individual can suffer over the course of their lifetime. Many assaults or incidents of violence can merely cause soft-tissue injuries and as such, the bones are not affected (Walker 2001: 584); therefore, skeletal lesions consist of only 40% of all injuries on the body (Judd 2008: 1665). The observable fractures seen on archaeological skeletal material represents a fraction of the injuries an individual could have suffered over the course of their lifetime (Walker 2001: 584). As such, the results gathered for the current project, and any project of this nature, will inevitably and always be underestimated (Judd 2008: 1665). Nevertheless, the comprehensive interdisciplinary nature of bioarchaeology gives these types of studies their strength as well as their capability to overcome such hindrances and interpretive difficulties (Larsen 1997, 2002; Owens 2007: 467; Wright and Yoder 2003: 56).

2.1.3 Bioarchaeology methods

2.1.3.1 The progression from case studies to population studies

In earlier bioarchaeological studies, rather than observing the patterns and tendencies that could be found within a population, they would instead focus on a specific incidence (Larsen 1997: 3). The emphasis was concentrated on analysing a specific bone or a specific fracture type. For example, the study would centre on how many right ulnae had suffered a fracture in the population, or some would be exclusively dedicated to the skull as a whole, such as Walker's (1989) study on cranial injuries found in a prehistoric skeletal population from Southern California. While these studies offer insightful information on one particular fracture type, it can cause problems when determining fracture aetiology as a single fracture on the body can be the result of any number of events (Judd 2002a; 2004: 46). If there are multiple fractures on a body, they may be linked to the specific fracture of interest and could subsequently affect the interpretation into its cause. Consequently, the initial assessment on the focal fracture could very well change depending on the presence of other lesions on the skeleton. Eventually, this preliminary evaluation would broaden its focus to all the injuries found on one particular individual and as such, case studies were the norm (Larsen 1997: 3). While case studies do focus on the entire skeleton, they can still present a missed opportunity as they concentrate on one individual rather than observing the total number of fractures seen on the available sample. This is a step in the appropriate direction versus studying a specific bone; yet, it still does not allow for patterns to emerge if the remaining individuals from the sample are not taken into account and analysed.

As a result, it has become apparent that a bioarchaeological approach is superior in its findings when evaluating skeletal remains from past populations in order to uncover possible patterns (Judd 2004: 467; Larsen 1997; Owens 2007), which in this case focuses on fractures and interpersonal violence. From these kinds of studies, it may be possible to determine whether a fracture is accidental or due to an incident of interpersonal violence, and how the fractures are related to the behaviours exhibited by a community (Larsen 1997). The surrounding context adds valuable information that may not be presented if the study aims to investigate a specific injury. As a result, it is very important to include all fractures seen on a body in order to properly interpret the trauma suffered by a particular individual. Furthermore, singling out an individual instead of viewing the population as a whole could also obscure information, especially concerning prevalence rates demonstrating violent tendencies seen within a community.

2.1.3.2 The use of clinical studies in bioarchaeology

Clinical analogy is used by bioarchaeologists in order to aid them with the identification and interpretation of trauma found on skeletal remains (Judd 2002b: 42; 2004: 34-35); it also acts as a baseline in order to measure such lesions (Walker 2001: 580). This is an integral part of the research as clinical studies can offer patient testimonies pertaining to the circumstances surrounding their injuries; evidently, retrieving this type of information regarding fractures seen on dry bone is not possible. As a result, clinical researchers have a large advantage over bioarchaeologists when determining a fracture's aetiology. Nevertheless, it is important to note that not all testimonies given to clinicians are irrefutable as some patients will no doubt lie regarding the way they sustained their injuries. For example, in the case of domestic violence, both the victim and the perpetrator may not want to disclose the assailant's violent behaviour to the clinical staff, and incidentally the police, as they may view it as shameful or a private matter. However, the breadth of information that can be retrieved from clinical studies outweighs that particular hindrance.

Similarly to the bioarchaeology studies of the past, many clinical studies focus on one specific fracture type such as maxillofacial, hand or rib fractures; while others will concentrate on fractures sustained by a specific aetiology such as assaults or motor vehicle accidents. These studies are usually derived from data collected from a particular area or city over a specific amount of time. As a result, they offer valuable information regarding the fractures sustained during a specific incident. In this case, the more focused subject matter of clinical studies is useful as the fractures' mechanism is habitually known to the researcher, unlike in bioarchaeology studies where it has to be interpreted. An array of different clinical studies was reviewed, even if the subject matter was not specifically related to violent behaviour and its resulting injuries. For example, a small number of clinical studies exploring the injuries resulting from motor vehicle accidents were examined. Obviously, these types of fractures will not feature on the skeletal remains of individuals from London during the 18th and 19th centuries; however, these studies do describe what happens to bone, and which fractures occur, when extreme forces are acting on the body. This information will give clues regarding which fractures could possibly be excluded, when analysing the prevalence rate of interpersonal violence within a population, due to the aetiology of the fracture being the result of a force greater than can be delivered by an unarmed human being. Clearly, the studies relating to accidents such as falls and incidents of violence or assaults were imperative as they contained valuable information on fracture aetiology that is of particular interest for this study.

2.2 FRACTURES

A fracture can be defined as a disruption in the continuity of the bone (Bennike 2008: 310; Chew and Hendrix 2002: 83; Roberts 2000: 337; Waldron 2009: 138). Having explored the available literature regarding violence, a wealth of knowledge regarding fractures has been obtained which is indispensable when identifying and interpreting such bony lesions. This section will explore the biomechanics of bone, the different types of fractures as well as their different causes or aetiologies, and how such lesions are identified on the body. Information regarding the healing process of fractures will also be presented.

2.2.1 The biomechanics of fractures

When a force acts upon a bone it will suffer changes to its anatomical form. The deformation will depend on a series of factors, both extrinsic, such as the magnitude of the force applied to the bone, as well as intrinsic factors, such as the degree of stiffness and the geometry (i.e. shape, size and position) of the bone (Dirkmaat et al. 2008: 43; Knüsel 2000: 383; Kroman and Symes 2012: 211-212; Rogers 2002: 20; Rubin and Rubin 2006: 36).

2.2.1.1 Types of forces that can act on bone

A fracture will occur when a bone is subjected to extraneous stresses such as: tension, compression, shearing, torsion or twisting, and flexion or bending (Galloway 1999d; Kroman and Symes 2012: 221; Lovell 1997; Ortner 2003: 120; Rubin and Rubin 2006: 36; Tencer 2010: 4; White and Folkens 2000: 384). Tension (Figure 2.1A) occurs when the bone suffers a force which aims to elongate the hard tissue and is applied in an outwardly direction, while compression (Figure 2.1B) aims to subject the bone to the opposite, shortening. Shearing (Figure 2.1E) stress is caused by opposing forces resulting in the bone sliding across another area of itself. Torsion (Figure 2.1 C) stress causes the force to act on the bone in a rotational directionality and the fracture itself will follow that course. Flexion

(Figure 2.1D) stress will cause the bone to bend (Galloway 1999d: 46-48; Kroman and Symes 2012: 221, 225; Ortner 2003: 121-124; Rubin and Rubin 2006: 36; Tencer 2010: 4). These stresses are interconnected and will inevitably occur in combination no matter the amount of force acting on the bone (Kroman and Symes 2012: 221; Ortner 2003: 120; Rogers 2002: 20).

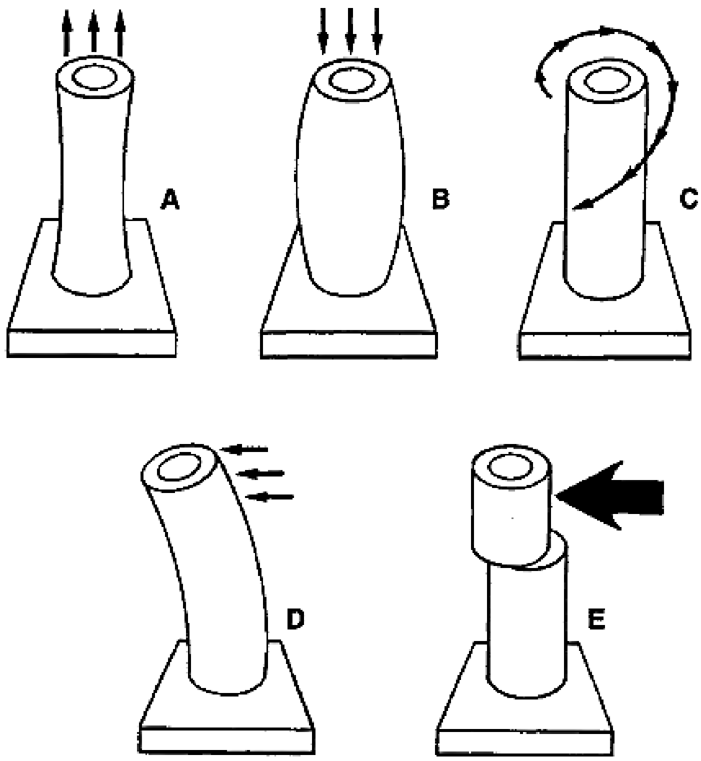


Figure 2.1 - Types of stress acting on bone: (A) tension, (B) compression, (C) twisting or torsion, (D) flexion or bending, and (E) shearing (Ortner 2003: 120).

The bone will have different failure levels conditional to the type of stress applied to the bone. Human bone is much stronger and will have a higher resistance when under compression as opposed to tension and shearing stresses (Bennike 2008: 313; Kroman and Symes 2012: 224; Tencer 2010: 13-15). This is the result of human adaptability to the constant compression stresses acting on the body due to bipedalism and daily activities (Kroman and Symes 2012: 224). Consequently, the area of the bone that is affected by tension stress will be the initial point of failure (Figure 2.2) (Kroman and Symes 2012: 226; Tencer 2010: 13-15).

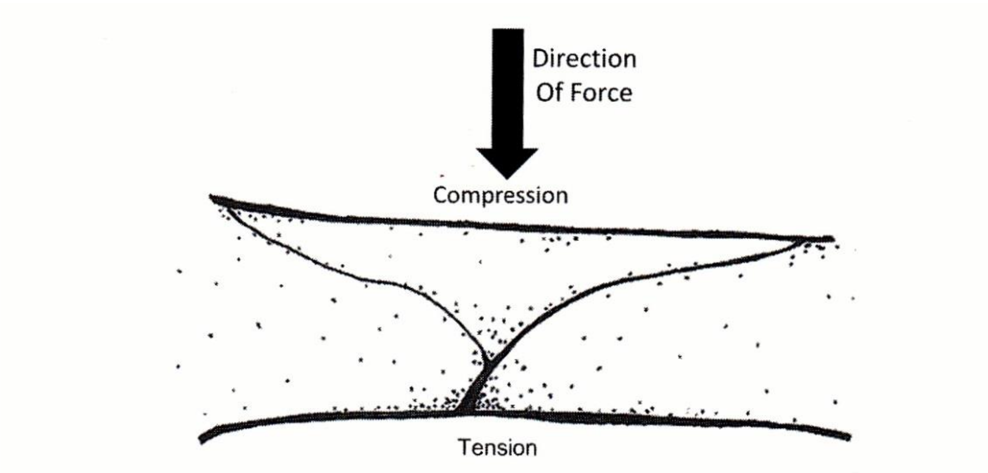


Figure 2.2 - Areas of compression and tension when force is applied to bone (Kroman and Symes 2012: 226).

2.2.1.2 Stages of deformation

When trauma is affecting bone, the material will go into its initial stage of deformation, the elastic phase. If the load deforming the bone does not surpass the elastic threshold, the bone will regain its original size and shape without permanent damage (Galloway 1999d: 37; Kroman and Symes 2012: 222; Rubin and Rubin 2006: 36). On the other hand, if the bone is pressured past its elastic stage and attains the plastic phase, a yield failure will occur and cause permanent damage. A visible fracture may or may not be evident in this case (Kroman and Symes 2012: 225). Finally, if the bone is stressed further, it will reach ultimate failure, or fracture (Galloway 1999d: 39; Kroman and Symes 2012: 222; Rubin and Rubin 2006: 37). Frequently, the force's original point of impact on the bone or the weakest area of the bone will be where the fracture originates (Kroman and Symes 2012: 223).

2.2.2 Types of fractures

Fractures seen on bone can be defined in a number of ways; yet they are initially categorised based on the degree of severity and the pattern of the break (Galloway 1999d: 48). They can be complete, where the fracture has created two or more fragments, or they can be incomplete, which results in the bone remaining in one piece. Simple fractures are indicative of a fracture producing two fragments while comminuted fractures present more than two fragments. Finally, there are open fractures, also known as compound fractures, which indicate that the fractured ends of the bone have pierced the skin; on the other hand, the fractures are closed when the skin is unbroken (Bennike 2008: 310; Galloway 1999d; Lovell 1997; Ortner 2003: 124; Waldron 2009: 139; White and Folkens 2000: 384).

2.2.2.1 Classification of fractures

Fractures can also be classified based on the type of fracture affecting the bone. Below are fracture type classifications with a brief description for each.

A transverse fracture (Figure 2.3) can be described as being approximately perpendicular to the length or long axis of the bone (Galloway 1999d: 52; Waldron 2009: 139) which follows how the force was applied to the bone (Lovell 1997: 141).

Figure 2.3 - The arrow shows a healing transverse fracture line seen on a left rib with bony projections. MoL CHB, FAO90 [1862].

An oblique fracture (Figure 2.4) is described as being rotational as well as angular on the axis of the bone (Lovell 1997: 141) and at an angle of about 45 degrees (Galloway 1999d: 54; Judd 2002b: 46; Waldron 2009: 139). This type of fracture can be confused with spiral fractures (Lovell 1997: 141).

Figure 2.4 - The arrows show a healed oblique fracture line seen on the proximal shaft of a left fibula with slight malalignment. MoL CHB, FAO90 [1521].

Spiral fractures can be described as twisting or circling around the long axis of the bone. They are the result of torsional forces (i.e. combination of shearing and twisting) which initially produce a small defect followed by fracturing along the tensile peak around the bone (Daegling et al. 2008: 1304-

1305; Galloway 1999d: 48, 54-55). This type of fracture can be confused with oblique fractures (Lovell 1997: 141).

A depressed fracture is typically found on the skull and can be described as a lesion which has been pushed below the outer surface of the cranial vault, or in other words, has caved inwards (Galloway 1999d: 51; Waldron 2009; White and Folkens 2000: 384). In many cases, only the outer surface is affected while the inner surface of the cranial vault retains its original shape (Galloway 1999d: 51). A picture of this type of fracture can be found below in section 2.2.6.1 (Figure 2.5).

A crush fracture is the resulting injury when a large area is subjected to a large amount of force (Galloway 1999d: 58). It is typically found on the vertebrae and can be the result of a fall from a certain height and where the feet absorb the force of impact (Waldron 2009: 141). To produce this type of fracture, the forces can be acting on one or both sides of the bone (Lovell 1997: 141).

Greenstick fractures are typically seen in children due to more elasticity being present in the bone. Consequently, their bones are much more flexible and less likely to break (Tomasto Cagigao 2009; Walker et al. 1997). A greenstick fracture is an example of an incomplete fracture and it is caused by a longitudinal compression which combines the breaking and bending of the bone (Lovell 1997: 141; White and Folkens 2000: 384).

Pathological fractures occur on bone that is also affected by a pathological process or condition. Consequently, the bone has been weakened (White and Folkens 2000: 384) and has become much more vulnerable to biomechanical stress (Ortner 2003: 119). Such fractures may have a very difficult time healing (Waldron 2009: 143).

Fractures can also be the result of repeatedly putting similar pressure or load on the bones and as such, suffer repeated episodes of trauma. They are identified as stress or fatigue fractures and are a common occurrence (Galloway 1999d: 40; Lovell 1997: 141; Waldron 2009: 151). Incomplete fractures, which will habitually form at a right angle of the long axis of the bone, can be the outcome if the stress is eliminated prior to the fracture becoming complete (Bennike 2008: 317; Merbs 1989: 168; Ortner 2003: 125).

2.2.3 Fracture healing process

Once a bone has been fractured, the healing process begins immediately (Lovell 1997: 145; White and Folkens 2000: 32); however, in order for the healing process to provide optimal results, the fracture must be reduced, which consists of returning the fragmented ends to their correct anatomical position, and then immobilised (Waldron 2009: 142). Nonetheless, the fractured ends will nearly always re-unite, even though non-union can occur; yet, there will be some displacement if the bone is not reduced and immobilised properly (Mays 1998: 165).

2.2.3.1 Healing phases

The preliminary phase of the healing process consists of the 72 hour period following the break where the blood supply to the area is increased as a haematoma forms around the fractured ends (Waldron 2009: 147; White and Folkens 2000: 32).

As a result of the change in continuity and during the next phase of healing, a callus made of woven, or primary, bone will begin to form in order to repair and reconnect the broken ends (Cattaneo et al. 2010: 22; Galloway 1999d: 44; Lovell 1997: 145; Mays 1998: 168; White and Folkens 2000: 32). The haematoma that formed at the site contains osteoblasts which will produce the collagen and cartilage that will form the callus (Waldron 2009: 147). As opposed to being smooth and organised, a callus can be very irregular with many bony projections, especially when it is first formed. This bony bridge between the fractured ends is detectable within weeks of the trauma occurring (Roberts 1991: 236).

As time progresses, the cuff of bone will become smoother and the bone will be remodelled to its original shape with the woven bone being gradually replaced with lamellar, or mature, bone (Galloway 1999d: 44; Waldron 2009: 148). The remodelling process, and final phase of healing, can take a number of years and its aim is to eventually obliterate any visible signs of the fracture having occurred (Lovell 1997: 145). The healing phases can vary in their respective amount of time since different types of bones (e.g. longs bones and cranial bones) have different healing processes and speeds (Ortner 2003: 126, citing Schinz et al. 1951-1952, *Roentgen Diagnostics: Skeleton, vol. 1 and 2*: 1603).

2.2.3.2 Factors affecting the healing process

The above description of the healing phases of fractures is the result of ideal circumstances; however, the time needed for the healing process varies greatly depending on a number of different intrinsic and extrinsic factors such as: age and health of the individual, the specific bone affected, type of fracture, stability of the fractured ends, and severity of the fracture (Bennike 2008: 311; Ortner 2003: 128; Powers 2005: 11).

The individual's age and the quality and health of the fractured bone will have the strongest effects on the healing process. The bones of younger individuals will heal at a much quicker rate than someone who is more advanced in age. Evidently, if a bone is healthy, it will heal at a more rapid rate than a bone that suffers from a pathological condition, (i.e. osteoporosis or Paget's disease, among others) or a nutritional deficiency (Waldron 2009: 148).

2.2.4 Identifying fractures on human remains

Fractures can occur on a skeleton over three time frames related to an individual's death: (1) prior death, (2) immediately prior, during or immediately after death, and (3) after death.

2.2.4.1 Ante-mortem fractures

Ante-mortem fractures occur any time prior to an individual's death and as a result, healing will have occurred which can present itself as the aforementioned visibly bony callus or as a smooth and rounded edge along the fracture line (Ortner 2003: 46). A healed lesion on bone may also be determined when the original shape of the bone is deformed via malalignment of the fractured ends as well as when there is a non-union of the healing bone fragments (Judd 2002b: 44).

2.2.4.2 Peri-mortem fractures

Peri-mortem fractures occur around the time of death, so they can happen shortly before or after death, or they can also be the cause of death. Such fractures present sharp edges as they have not begun to heal (Waldron 2009: 148). Identifying these fractures can be difficult as they can often emulate characteristics that are caused by post-mortem taphonomic damage and resemble post-mortem fractures (see below) (Domett and Tayles 2006: 186; Van Der Merwe et al. 2010: 292). It does occur that peri-mortem fractures are not identified or recognised as such when analysing dry bone (Kroman and Symes 2012: 229; Waldron 2009: 138).

2.2.4.3 Post-mortem fractures

Post-mortem fractures affect the human remains after death. There can be a number of taphonomic factors that disturb the bones and consequently fracture them. For example, if a body is buried in a grave, the soil covering the remains can provide extra weight and pressure on the skeleton which leads to possible fragmentation of the ribcage, pelvic girdle and skull (Waldron 2009: 138). Further damage can also be the result of the excavation process (Ortner 2003: 46). Post-mortem fractures are normally recognisable by the lighter colour of the bone seen at the fracture site (Ortner 2003: 46; Waldron 2009: 138) due to the surface being affected by taphonomic factors such as the soil and weather. Furthermore, the edges of the lesion will be sharp, jagged and irregular compared to the smooth and rounded edges seen on the anti-mortem lesion (Ortner 2003: 46).

2.2.5 Fracture mechanisms

Fractures are a frequent result when one suffers an incident of physical trauma; and, determining their mechanism is not a straightforward task. Numerous authors (Brickley and Smith 2006; Judd 2002a, 2002b, 2004; Jurmain and Bellifemine 1997; Larsen 2002; Lovell 1997; Mays, 2010; Walker 2001) have declared that single fractures can be the result of any number of incidents and are not necessarily related to violence even if they present characteristics that would identify them as being a possible marker of interpersonal violence.

A number of different incidents can create the fracture types mentioned above; therefore, additional information must be recorded, such as the directionality of the force acting on the bone as well as the angle of the resulting fracture line, in order to properly interpret a fracture's aetiology when analysing skeletal material. The fracture line will divulge clues regarding whether the acting force on the bone is direct or indirect, which will in turn begin to reveal the fracture's mechanism. Lastly, recording a fracture's location on a bone is of the utmost importance in order to properly identify its mechanism and cause, as a fracture located on the proximal end of a bone can very well reveal an aetiology that is completely distinct from the cause of a fracture seen on the distal end of a bone.

2.2.5.1 Fractures possibly caused by interpersonal violence

When fractures possibly due to interpersonal violence occur, a direct force is acting on the bone. This kind of force is usually the result of a localised blow and it will produce a transverse fracture line (Galloway 1999d: 57-58; Jurmain et al. 2009: 467; Lovell 1997: 141). That force is usually of a low magnitude (Rogers 2002: 21), which will produce fractures that are commonly less severe than what would be caused by a greater amount of force. There are fractures that are repeatedly described in the literature as being possible markers of incidents of interpersonal violence and they will be explored below in section 2.2.6.

2.2.5.2 Accidental fractures

Accidental fractures, on the other hand, will present features that can be distinguishable from the characteristics described above. Similarly to possible markers of interpersonal violence, accidental fractures can be caused by a direct force; however, they can also be the results of an indirect force (Judd 2002a: 102; 2002b: 46; Jurmain et al. 2009: 467) which will produce fractures beyond the immediate site of impact (Galloway 1999d: 58; Lovell 1997: 142). Due to the extra amount of force and the larger area of impact habitually associated with accidents, such incidents can cause more than one fracture in the same area, while a localised blow tends to only display a singular fracture, especially when looking at the ribs (Galloway 1999b: 107; Rodriguez-Martin 2006: 205; Rogers 2002: 21). Nonetheless, it is important to remember that if an individual is in poor health and their bones are pathologically affected, accidental fractures can occur with a minimal amount of force.

When bone is affected by an indirect force, the resulting fractures will present an oblique line rather than a transverse line (Judd 2002b: 46; Jurmain et al. 2009: 467; Lovell 1997: 141; Neri and Lancellotti 2004: 62). Habitually, fractures seen on the lower limbs as well as the humeri are the result of accidents (Judd 2002b: 51; Kilgore et al. 1997; Rodriguez-Martin 2006: 206-207) as perpetrators will usually aim for the head and face especially (Brickley and Smith 2006: 64; Hassan et al. 2010: 29; Judd 2004: 49; Le et al. 2001; Shepherd et al. 1990: 78; Walker 2001: 582), and at times the ribcage (Lovell 1997: 166), when assaulting an individual.

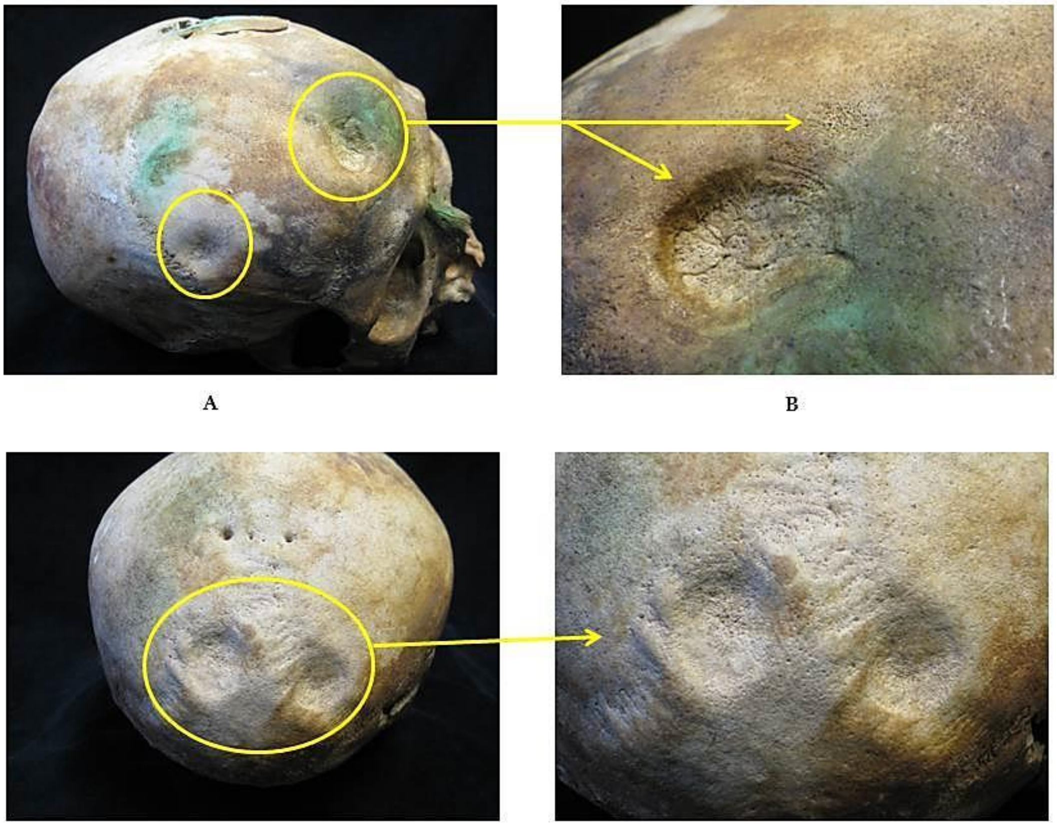
2.2.6 Possible markers of interpersonal violence

The information on fractures presented above enables the classification of certain fracture types. Throughout the review of the bioarchaeology and clinical studies, certain possible fracture markers of interpersonal violence would continuously appear. The fracture types that were found to be more commonly associated with incidents of interpersonal violence are as follows: depressed cranial fractures (Avrus 1999: 427; Judd 2002b: 49; Lambert 1997; Lessa and Mendonça De Sousa 2004: 377; Smith 1996: 90; Torres-Rouff and Junqueira 2006: 63; Walker 1989), nasal fractures (Galloway 1999a: 75; Hershkovitz et al. 1996: 177; Judd 2002b: 49; Le et al. 2001: 1282; Lessa and Mendonça De Sousa 2004: 377; 2006; Lovell 1997: 166; Walker 1997), ulnar fractures (Judd 2002a: 100-101; 2002b: 51; 2004: 46; 2008; Kilgore et al. 1997: 111; Lessa and Mendonça De Sousa 2004: 377; Rodriguez-Martin 2006: 206-207; Smith 1996: 84; Steyn et al. 2009: 2; Van Der Merwe et al. 2010: 12), rib fractures (De La Cova 2010: 595-596; Galloway 1999b; Hershkovitz et al. 1996: 177; Judd 2002a: 102; 2002b: 50; Lovell 1997: 166; Matos 2009; Steyn et al. 2009: 2) and metacarpal fractures (Brickley and Smith 2006: 164; Burrows 1908; Butt 1962; De La Cova 2010: 595-596; Galloway 1999c: 155; Galloway 1999e: 228; Greer and Williams 1999; Hershkovitz et al. 1996: 177; Judd 2002b: 50; 2006: 328; Lovell 1997: 163). As a result, when analysing the skeletal material, special attention was given to these fracture types in order to properly identify their aetiology in the event that they may have been caused as the result of an accident. Below is a description for each designated possible marker of interpersonal violence and their features which serve to possibly distinguish them from accidental fractures.

2.2.6.1 Depressed cranial fractures

A description of the features of this fracture type is found above in section 2.2.2.1. A depression (Figure 2.5) is commonly caused with a small weighted object that strikes the cranium with a high-velocity force; if the object is heavier and is propelled by a low-velocity force, radiating fractures are often the result (Galloway 1999a: 67).

Walker (1989) studied a population from Southern California and found that depressed cranial fractures could be the result of interpersonal violence due to a culturally regulated pattern of violence which produced many injuries of similar size and shape (1989: 319). However, he states that these fractures can also be the result of an accidental fall or of a culturally specific custom where the fracture is self-inflicted (1989: 318). In modern cases, it is found that they are commonly due to incidents of violence (Hassan et al. 2010; Lessa and Mendonça De Sousa 2004: 377; Stables et al. 2005).



A B C D

Figure 2.5 - Depressed cranial fractures, with no radiating fractures, found on the cranium of [1827], a male over the age of 50 from FAO90 (MoL CHB). Three depressed fractures are seen on the frontal bone (A), one is located on the right side of the bone near the coronal suture and two are located above glabella (B). Two other depressed fractures are seen on the occipital bone (C and D).

Depressed cranial fractures resulting from interpersonal violence will display a regular shape, such as ovoid or circular, and are generally located in the vicinity of the frontal bone. If the cause is accidental, the lesion tends to have an irregular shape, is delineated by the presence of radiating fracture lines and its location on the cranium is habitually not standardised (Lessa and Mendonça De Sousa 2004; Walker 1989).

2.2.6.2 Nasal fractures

Nasal fractures can be associated with interpersonal violence since the nose is a prominent feature on the face (Brickley et al. 2006: 126; Brickley and Smith 2006:

164; Le et al. 2001: 1282) and it is psychosomatically linked to the victim's identity in the mind of the perpetrator (Galloway 1999a: 63). The expressions related to the nose, along with other body parts such as the mouth, belly and genitals, are capable of profuse communication and do so in all languages (Synnott 2002: 21, citing Bakhtin's (1968: 319), *Rabelais and His World*). An injured nose can lead to an insinuation regarding an individual's character and behaviour without a single word being spoken. As a result, targeting the nose is culturally liable and usually presented as acceptable due to its presence in socially ritualised fighting (Walker 2001: 582) and could be viewed as an ideal target for an assailant.

In Britain's early modern culture, the nose had symbolic overtones and would greatly disgrace an individual if it was injured (Hurl-Eamon 2005: 80-81; Shoemaker 2004: 57). It will be seen over the course of this thesis that upholding one's honour and reputation was an important aspect of life in London during the eighteenth and nineteenth centuries, and violence was often used to correct improper behaviour or to teach lessons. Consequently, humiliating one's opponent could be prolonged after the fight itself by targeting and injuring the nose so that their disgrace could be witnessed by many other individuals who did not witness the dispute. Furthermore, men used it as a symbol of infidelity to accuse their wives of sexual dishonour, especially if she had contracted syphilis which manifests lesions in the nose (Shoemaker 2004: 57).

Nasal fractures (Figure 2.6) are the most common type of fracture resulting from blows to the face (Brickley and Smith 2006: 164; Karagama et al. 2004: 968; Perkins and Dayan 2002: 1; Walker 1997: 154), and they are habitually instigated due to the delicate nature of the bones (Brickley and Smith 2006: 164; Galloway 1999a; Le et al. 2001: 1282; Lessa and Mendonça De Sousa 2006: 134). Transverse fractures occur on one or both bones when the bridge of the nose receives the impacting force. If the force is more intense, the nose will be pushed to the side and linear fracture lines can be seen on the maxillae (Walker 1997: 154). Accommodatingly to this kind of study, healed nasal fractures are visible on the bone over a long period of time. Furthermore, if it has not healed properly, the displacement infers a traumatic incident (Lessa and Mendonça De Sousa 2006: 134).

Figure 2.6 - Healed nasal fracture on a male between 20-34 years of age. MoL CHB, FAO90 [2015].

Simple nasal fractures are often the result of an incident of violence (Lovell 1997: 156) due to the low magnitude force driven behind the attack. Nasal fractures can also be the result of accidents (Avrus 1999: 427; Galloway 1999a: 75-76; Karagama et al. 2004: 968); however, in this case, they become more severe and affect other maxillofacial bones (Perkins and Dayan 2002: 2).

2.2.6.3 Ulnar or 'parry' fractures

This type of fracture has introduced a large amount of dialogue in the literature, particularly in regards to determining its mechanism as fractures on the forearm can also be the result of accidents (Judd 2002a, 2008). There is an array of fractures that affect the forearm, such as Colles', Smith's, Monteggia and Galeazzi fractures, which habitually affect the radius (Judd 2008). However, they do not always leave the ulna intact. In this case, fractures found on the ulna rather than the radii are of interest and more specifically, the focus will be on the 'parry' fracture.

The aetiology will define whether or not a fracture of the ulna is in fact a 'parry fracture' (Judd 2008; Lovell 1997; Walker 2001) which is a perfect example of properly identifying and describing the fracture's characteristics. A fracture on the ulna is given the connotation of a 'parry' fracture when it is the result of raising the arm to parry off a blow, a classic defensive movement to protect one's head and it is usually executed with the dominant arm (Galloway 1999b: 141; 1999e: 227; Judd 2002b: 51; 2008: 1661; Kilgore et al. 1997: 111; Rodriguez-Martin 2006: 206-207; Smith 1996: 84). Parry fractures are described as being located on the middle or distal shaft of the ulna, while leaving the radius intact (Galloway 1999c: 135; Judd 2008). Furthermore, there is a slight displacement of the distal fragment and the fracture line is typically transverse or at times slightly oblique (Avrus 1999: 422; Judd 2002b: 51; 2008).

However, this type of fracture can also be the result of an accident, such as the twisting of the arm (Lovell 1997; Walker 2001: 581-582) or breaking a fall with the palms outstretched (Judd 2002b: 46; Kilgore et al. 1997: 111-112; Lessa and Mendonça De Sousa 2004: 377-378). Paired radioulnar fractures can also occur (Figure 2.7); yet, they are usually the result of accidental causes as they require more force in order to fracture both forearm bones (Chew and Hendrix 2002: 88; Judd 2002a: 93; 2004: 46; 2008: 1662; Kilgore et al. 1997: 111-112).

Figure 2.7 - Paired healed fractures on the left ulna and radius of a male between the ages of 20 and 35. Both fractures have an oblique fracture line with posterior displacement. MoL CHB, OCU00 [782]

2.2.6.4 Rib fractures

Rib fractures (Figure 2.8) can be very difficult to analyse. As a result, they are not always considered in studies of interpersonal violence even though they are common in both the clinical and archaeological settings (Brickley et al. 2006: 124). The degree of preservation can have a very large impact on the ability to analyse the ribs as they are not as sturdy as some of the other bones found in the skeleton. Also, they can just as easily be the result of an accidental fall or be the result of severe coughing; yet, in this case there tends to be other intrinsic factors affecting the bones which help to identify the mechanism, such as the presence of osteoporosis (Delabarde 2008: 238; Judd 2002a: 102; Roberts 2000: 339; White and Folkens 2000: 384). The ribs' reaction to blunt force can result in various patterns, determined by the point of impact; and in turn, this hinders their mechanism's interpretation (Delabarde 2008; Kimmerle and Baraybar 2008: 224).

In this case, a fracture's location is of particular importance in order to properly determine how it occurred.

Figure 2.8 - Healed rib fractures, displaying slight medial displacement, seen on three right ribs from a female between the ages of 35-49. MoL CHB, FAO90 [1903].

In the case of non-accidental rib fractures, they tend to be located bilaterally on the ribcage (Galloway 1999b; 1999e: 229; Hershkovitz et al. 1996: 177). Furthermore, the fracture lines will be transverse (Galloway 1999b: 107; Judd 2002a: 102; 2002b: 50) and at times the sternum can be affected, which is usually caused by repeated blows to the chest (Fowler 1957; Galloway 1999e: 230; Rodriguez-Martin 2006: 206). Additionally, if an individual's rib cage demonstrates multiple healed fractures and presents different stages of healing, which is exhibited by the presence of differently sized bony calluses, it could indicate that the individual was repeatedly physically abused (Delabarde 2008: 244; Judd 2002a: 102; 2002b: 50; Kimmerle and Baraybar 2008; Lovell 1997: 166; Walker 2001).

However, rib fractures due to accidents can be distinguishable as they are usually located unilaterally on the ribcage (Delabarde 2008: 238; Galloway 1999e: 229) and they will exhibit oblique fracture lines (Galloway 1999b). One incident can also cause multiple fractures especially if the impact area is large (Delabarde 2008: 236; Galloway 1999b: 107; Rodriguez-Martin 2006: 205) and as they heal, they will present bony calluses that are at a similar stage in the healing process, unless that process has been interrupted. Additionally, the bones of the upper limbs from the same side of the body which took the brunt of the impact can also be affected (Delabarde 2008: 238). Finally, accidental rib fractures tend to be located on the posterior ribcage (Galloway 1999b; Judd 2002a: 102; Matos 2009: 35).

2.2.6.5 Metacarpal fractures

Metacarpal fractures can also be used as a marker for interpersonal violence. They are common and are frequently seen on either the first or fifth metacarpal (Galloway 1999c: 152). Some healed metacarpal fractures produce thickening of the proximal end of the bone (Burrows 1908: 742) and overall shortening of the bone (Figure 2.9), which facilitates the detection of such a lesion. Frequently, a longitudinal compression is the driving force behind the fracture, which is a consequence of boxing (Lovell 1997: 163).

Figure 2.9 - Healed fracture on the proximal end of a right first metacarpal of a male over the age of 50, as shown on the right photograph. The left photograph shows the shortening caused by the fracture when compared to the left first metacarpal. MoL CHB, FAO90 [2191].

These fractures can bring to light the fact that an individual participated in hand-to-hand combat or defended themselves against an assailant (Brickley and Smith 2006: 164; Judd 2006: 328; Lovell 1997: 143; Novak 2000). Fractures to the neck of the fourth and especially the fifth metacarpal (termed Boxer's fractures) tend to unveil offensive actions (Brickley and Smith 2006: 164; Galloway 1999e: 228; Greer and Williams 1999). The boxer's fracture on the fifth metacarpal will occur when a punch is thrown at an angle (Ali et al. 1999: 835). Furthermore, a Bennett's fracture, seen on the shaft of the first metacarpal, can also be the result of throwing a punch and is also related to boxing (Brickley et al. 2006: 126-127; Burrows 1908; Galloway 1999c: 155). As a secondary effect to the force acting on the closed fist when connecting with a target, the thumb becomes either hyperextended or hyperabducted which will cause the Bennett's fracture (Galloway 1999c: 155). Burrows (1908) examined a number of patients, including a pugilist, with this type of fracture and some mentioned having been involved in fighting prior to the injury. The pugilist further mentioned missing his intended target, the opponent's jaw, and connecting with the upper arm instead (Burrows 1908: 741). As such, this fracture is of interest as boxing matches became popular entertainment, in the 18th and 19th centuries, and London was no exception (Bayne-Powell 1937: 170-171; Richardson 1995: 117-188; Shoemaker 2004: 153-154). It even became an activity of English national identity by the 1750s (Wood 2004: 72).

However, metacarpal fractures can also be the result of accidental trauma to the hands (Brickley and Smith 2006). Inconveniently, fractures of the fifth metacarpal can also be the result of a fall for example or hitting one's hand against a solid object (Butt 1962: 731). Metacarpal fractures can also be the result of occupational activities, such as operating machinery where the hand is crushed or traumatised in some other fashion, or they can even be associated with riding accidents (Brickley et al. 2006: 126-127). Again, the similar fractures due to varying mechanisms reinforces the notion that proper description of the characteristics of the fracture is essential to studies focusing on interpersonal violence seen on skeletal material.

2.3 LIFE DURING POST-MEDIEVAL LONDON

London was chosen as the geographic epicentre for this project due to its well documented history and the availability of research materials. The Museum of London's Centre for Human Bioarchaeology (MoL CHB) curates a large collection of skeletal remains exhumed from Roman cemeteries to post-medieval burial grounds. The skeletal material used for this study was excavated from six burial grounds found in the Greater London area and were dated to be in use approximately between 1750 and 1850. A description of each burial ground, along with historical information relating to its location and associated parish is found in section 3.2 of Chapter 3. The information presented below provides a context for the skeletal material that was analysed during the laboratory phase of the project.

Post-medieval London was subjected to an enormous array of changes and evolutions that began well before the two centuries under study. This transformation greatly affected the quality of life endured by the citizens of the City and its boroughs, including the individuals whose skeletal remains were analysed for this study. As a result, the description of London will explore the major changes that occurred, especially during the eighteenth and nineteenth centuries. This general summary allows for a more in-depth look at the contrast between the living conditions of the poor and the wealthy, as well as the social roles allotted to men and women and how they differentiate when looking at populations that are at opposite ends of the social and economic spectrum. Finally, in order to be able to properly interpret fractures and come to a conclusion on whether or not they are possibly caused by incidents of interpersonal violence, Londoners' attitude towards such incidents will be examined.

2.3.1 London Life

The Industrial Revolution brought a number of changes to various aspects of the lives of Londoners, such as agriculture, manufacturing, and transportation, among others. However, this was not the beginning of the changes seen in London as many more had occurred during the prior centuries as well. In this section, the enormous growth rate seen in London will be explored as well as its negative effects on the degree of the sanitary conditions found within the boundaries of the metropolis. Additionally, since the human remains were exhumed from burial grounds, the general conditions of cemeteries will be explored which were of course also affected by the changes seen in 18th- and 19th-century London.

2.3.1.1 Population growth

The fortified walls seen around Londinium in Roman times survived until the eighteenth century. However, London grew past those walls and saw its population expand massively beginning in the sixteenth century: 75,000 inhabitants in 1550; 200,000 in 1600; 575,000 in 1700; 960,000 in 1801 and London's population reached 1.6 million residents 30 years later (Sheppard 1998: 126). By the year 1800, London's population was tenfold that of the next largest city in England, Manchester (Black 2009: 168), it had become the third largest city in the world, behind Peking and Edo (Tokyo) (Thorold 1999: 127), and it had also become the wealthiest city in England and the Americas (Black 2009: 168; Green 1995: 5). This population growth was due mainly to immigration, but by the nineteenth century the high birth rate, increased by the fertility of the young population, was enough to keep the city growing (Black 2009: 230).

During this period of growth, which transpired over three centuries, the eastern suburbs of London greeted the largest number of new residents, the vast majority of which were essentially poor migrants (Richardson 1995: 98; Sheppard 1998: 171; Thorold 1999: 7). After the Great Fire of 1666, the City and the borough of Westminster became one metropolis but the City continued to operate as a single entity (Richardson 1995: 98). The various parishes found around the City still had many administrative powers (Sheppard 1998: 215) and were in essence the local government within their respective geographical boundaries, until the Victorian era (Picard 2006: 73; Shoemaker 2004: 19). Many of the migrants chose to live outside the ancient walls as the City was more strict in terms of its authority than other areas of London (Black 2009; Sheppard 1998: 196). The south side of the Thames also began to grow in the late sixteenth century and it continued as the area became more and more industrialised and accessible via the construction of bridges (Johnson and City of London 1969;

Reilly 2009; Reilly et al. 2001; Reilly and Southwark 1998; Sheppard 1998; Thorold 1999). The western suburbs saw its core period of growth during the seventeenth century (Croot 2004; Russett 2004: 79; Sheppard 1998: 171; Thorold 1999). This exodus to the west of London was principally due to the rich wanting to flee the large influx of poorer migrants to the east and its associated consequences such as pollution and overcrowding (Borer 1973: 8; Green 1995: 7-8; Thorold 1999).

2.3.1.2 Sanitation

The growth of London also brought with it very negative side-effects, especially regarding the availability of a clean water supply and sanitation (Black 2009; George 2000: 17; Picard 2006: 78; Roberts and Cox 2003: 296-297). Many individuals, especially the poor, lived in neglected accommodations which were teeming with other occupants (Picard 2006: 90; Roberts and Cox 2003: 296-297; Wood 1991: 16). Due to the massive growth and overcrowding in some areas of the city and its surrounding boroughs, the environment quickly became industrialised and very polluted with a thick layer of smog covering the city which affected everyone regardless of their social and economic circumstances, residents and visitors alike (Thorold 1999: 125).

The Thames was a main source of drinking water for many Londoners until the early nineteenth century (Picard 2006: 78; Reilly 2009: 71; Reilly et al. 2001: 75-76; Werner 1998: 88). It had previously been a very lovely place to swim and would yield large amounts of fish (Borer 1973: 7; Holme 1972: 61; Walford 1878a; Walker and Jackson 1987: 161). Nevertheless, the river became more and more polluted as time progressed due to the seepage of gasworks and on-going problems with the sewage system (Borer 1973: 191; Croot 2004; Reilly 2009: 71; Reilly et al. 2001; Walford 1878b; Werner 1998: 88). Consequently, the Thames quickly developed a very foul odour (Thorold 1999: 247; Walford

1878b). The population of post-medieval London had become very susceptible to the spread of various diseases as a direct result of the declining quality of the water source (Black 2009: 255; Green 1995: 182), which accounted for very high mortality rates during certain periods.

2.3.1.3 Condition of cemeteries

An extension of the sanitation problems that occurred following the changes described above is the condition of the cemeteries found throughout London and its suburbs. As a direct result of the overwhelming growth rate of the population, as well as the vast presence of disease, cemeteries were becoming more and more overcrowded, especially after the Plague in 1665 (Bard 2008; Gittings 1984: 139; Harding 1989; Picard 2006: 361; Reilly and Southwark 1998: 60; Walker and Jackson 1987: 46).

Due to the large need for burial space, as many as twelve individuals would be laid to rest within one burial plot, fifteen if the cemetery was reserved for paupers (Picard 2006: 369). This continued during the next centuries even with the procurement of overflow cemeteries (Bard 2008; Brooks 1989; Denny 1997: 86; Holmes 1896; Houlbrooke 1998: 334-335; Picard 2006: 361). At times, these extra sites were not enough and some burials were exhumed prior to being entirely decomposed or an extra layer of soil, usually using ship's ballast, was placed so that more individuals could be interred (Walker and Jackson 1987: 46).

Once the cemeteries were no longer in use, they were abandoned and uncared for (Richardson 1995: 202). Due to the shallowness of the burials, the cemeteries began emitting a foul stench (Bard 2008: 9). As a result, until the mid-nineteenth century, they became a very large source of infection as the nearby local water source would be affected by the decomposing bodies which in turn was exacerbated by adjacent overflowing cesspits (Bard 2008; Black 2009:

257; Brooks 1989). It was only after a persistent public campaign that some of these closed cemeteries were subsequently transformed into gardens (Richardson 1995: 202).

2.3.2 The London poor

The social diversification seen in London became much more fixed during the seventeenth century. Prior to the Great Fire, many of the poor lived on the immediate periphery of the City and near the Thames (Sheppard 1998). Afterwards, many of London's poor, displaced by the destruction caused by said fire, moved to the East End in search of cheap housing as they could no longer afford to live within the rebuilt City (Richardson 1995: 98). However, some drifted towards and remained in the West End (Black 2009: 118).

2.3.2.1 The slums

The living conditions for the poor were fundamentally the same in both the urban and rural areas of England (Holme 1972: 236; Roberts and Cox 2003: 296-297). The dwellings for the very poor were essentially squalid slums which could be found in a number of areas of London, not just the East End (Black 2009; Denny 1997: 119; Golden 1951: 23; Green 1995; Holme 1972: 154; Picard 2006; Thorold 1999). Some buildings in which they resided were built before the Great Fire, while others were originally prosperous houses that had been abandoned by the rich as they moved westwards. However, these former opulent houses were looted by squatters and in essence nothing but the bare walls were inherited by the very poor who would pack in as many people as possible (Picard 2006: 55). The living conditions within these slums oftentimes subjected the residents to live next to a half-stagnant open sewer, which caused problems with the adjacent cellars as well as the backyards (Thorold 1999: 250). The poor quality of life of these individuals was exacerbated by inadequate nutrition, the demands of hard labour as well as the previously mentioned over-crowding and pollution (Black 2009: 257; Coates 2000; Hitchcock 2004).

2.3.2.2 The bane of the population

Dealing with the poor and the sheer size of the population characterised as such was virtually the only major problem encountered by the government, until the nineteenth century (George 2000; Green 1995; Hitchcock 2004; Johnson and City of London 1969: 324; Wood 1991). The authorities would attempt to destroy the slums due to their over-crowded and unsightly nature by demolishing them and building roads in their centres. However, this would simply drive out the poor, who would be inevitably forced to congregate with, or altogether create another slum (Black 2009: 275; Green 1995; Picard 2006: 90; Thorold 1999: 251). Workhouses were built in order to adjudicate and reprimand vagrancy, prostitution and other petty crimes (Sheppard 1998: 197), but they also served as an effort to resolve the vast level of poverty in London (Green 1995; Hitchcock 2004: 133; Picard 2006: 97; Reilly and Southwark 1998: 31; Wood 1991). Nevertheless, voluntarily going to the workhouse was a last resort for many of the poor, usually taken out of desperation, as it meant giving up one's family and one's self-respect as a free citizen of London (Picard 2006: 93; Reilly et al. 2001: 82; Richardson 1995: 187). In the minds of the various London parishes, the poor were a scourge on the population and the parishes would fiercely try to force them on to other parishes in an attempt to avoid having to support these individuals, and further deplete their monetary resources, as per the Act of Settlement proclaimed in the early 1700s (George 2000; Johnson and City of London 1969; Sheppard 1998: 215; Wood 1991).

2.3.3 The London rich

Initially, the wealthy residents of London could be found within its ancient Roman walls (Sheppard 1998). However, as the poor population became ever larger, the rich would try to escape this influx by settling in the west or northwest of London (Earle 1989: 205; Thorold 1999: 7). Even so, as mentioned above the rich could still not completely escape the poor as some also chose to live in the West End (Black 2009: 118). On the other hand, the move to the West End did allow a certain escape from the pollution, smell and unsanitary conditions found within the City (Black 2009: 118; Thorold 1999: 30); yet, these more sanitary conditions would eventually become those exact circumstances that the wealthy were trying to escape.

2.3.3.1 The extravagant upper-class lifestyle

Many wealthy individuals built or purchased manor houses in the country which were used as secondary homes, during weekends and the summer, and allowed a further escape from the City (Thorold 1999: 56). The upkeep and renovations for these dwellings was continuous and ever more opulent with the construction of ballrooms in certain cases; furthermore, it was of the utmost importance that the inside of the manor always be impeccable (Thorold 1999: 265). The upper-classes employed many individuals as domestic servants which helped the poor find employment (Earle 1989; Green 1995: 5; Meldrum 2000; Picard 2006; Sheppard 1998: 218-219). Some even employed French cooks in order to broaden their diets with soups and sauces which were lacking in English cuisine (Thorold 1999: 119). On the other hand, there would be a sharp drop in demand for domestic servants when the rich seasonally retreated to the country. The poverty situation found in London would inevitably be aggravated as a direct consequence since domestic servants did not follow them westward during those times (Green 1995: 7-8; Thorold 1999: 20). Due to the widening expanse between the rich and poor areas of London, many wealthy individuals did not understand or simply did not care to find out about the dire circumstances and living conditions experienced by the poor (Green 1995: 186).

Once it came to light, the wealthy attributed the blame for such a horrid life to the poor individuals themselves and their vices, carelessness and laziness (George 2000: 62-63; Gittings 1984: 65).

2.3.3.2 The emergence of "Nouveau Riche"

The wealthy communities were also growing, but not due to an influx of poorer people settling in the same communities. The people from the middle-class were quickly becoming part of the rich social class as they were making more money and living longer, which allowed them to live a more comfortable life while being able to accumulate more wealth (Thorold 1999: 133). During the eighteenth century, London saw many more people enjoy a more luxurious lifestyle that had in the past been reserved for a only small portion of the elite (Sheppard 1998: 198). Many of the modern and fashionable manors constructed during that time were commissioned by those with newly acquired wealth (Thorold 1999: 56).

2.3.4 Gendered social norms

Popular beliefs, religion and the government found in England, which held the notion that women had an inferior social status than the men, had an effect on how the sexes led their lives, as well as how they contributed to and participated in society.

2.3.4.1 The public and private spheres of society

Men, as the dominant sex, could participate in the public sphere of society outside the household, while the submissive women belonged to the household's private sphere (Clark 1992: 191-192; Doggett 1992: 93-94; Hunt 1992: 27). There were a number of jobs available for men, such as: tradesmen, shopkeepers, manufacturers, artists and finally professionals which were characterised as men who used their heads rather than their hands (Earle 1989:

3; Sheppard 1998: 219). As for the women, especially those within the upper-classes, they were confined to their homes, while men worked outside the home, as their responsibilities revolved around the housework or the supervision of servants to ensure the proper running of the household (Meldrum 2000: 41). On the other hand, a poor woman would not find it necessary to clean her dwelling in the slums and as a result, she would find employment outside the home (Picard 2006: 304). Poorer families would need everyone to contribute to the family's economy (Clark 1992: 189); as a result, unlike the wealthier women who would majorly participate in the private sphere, a poorer woman would have to join both the private and public spheres in order for her family to survive.

2.3.4.2 "Women's work"

A married woman would contribute to her family in an economic manner by being a mother and housewife (Johnson and Nicholas 1997: 203-204) and as such, she helped maintain the social status quo. On the other hand, the employment options for women who needed to work were limited. In order to keep the balance of power and authority over women afforded to them by the cultural and social norms, men would restrict the types of jobs available for women and in doing so, try to force them out of the workforce altogether by allowing them to solely work as unskilled labourers or for very little compensation.

Many of the jobs available to women were temporary or casual, and they were limited to: the needle trade, laundering or retail (Green 1995: 23; Sheppard 1998: 233). These jobs had the lowest compensation rates and were characterised as being some of the worst available within the "sweated" trade (Johnson and Nicholas 1997: 216). These jobs were characterised as an extension of their responsibilities within the home (Green 1995: 23). Furthermore, female migration to London during the 1700s was much higher than the male rate of migration (Meldrum 2000: 12; Sheppard 1998: 206); consequently, many single women would find employment as domestic servants (Sheppard 1998: 206) and they were four times more likely than men to be employed in domestic service (Meldrum 2000: 33). A manservant was typically seen in larger and elite households (Meldrum 2000: 33) and they would have jobs such as coachmen, grooms and other more outdoor type responsibilities (Sheppard 1998: 218-219). Of course there was always prostitution, but that option was usually chosen out of desperation when no other employment option was available (Hitchcock 2004: 88; Richardson 1995: 198; Sheppard 1998: 196).

As the 19th century progressed, the evolution of the technology and machinery stemming from Industrial Revolution seemed to alleviate the restrictions enforced on working women. The industrialization presented an opportunity for women to obtain employment within that sector which was better paid than what was previously available to them. Furthermore, the increased demand for skilled labour contributed to gender barriers present in the workforce becoming more and more obsolete. Consequently, this also changed the balance of power within households as responsibilities were shared due to the woman increasing her status in the family (Johnson and Nicholas 1997: 204).

2.3.5 Violence in London

2.3.5.1 Crime in London

As a whole, during the seventeenth and eighteenth centuries, London society would not preoccupy itself with prosecuting violence, with the exception of homicide cases (Hurl-Eamon 2005: 2); however, violence in London was not limited to such cases. The over-crowded nature of the dwellings, the fact that many individuals dealt with strangers every day, and the increasing autonomy within the urban setting exacerbated the tendency for more aggressive and violent outbursts than what was seen in rural settings (Hurl-Eamon 2005: 7). Moreover, there would be an increase of crime in London following times of war, mostly due to the fact that the men were accustomed to fighting and would return to a less than ideal employment situation emphasised by poverty and despair (Black 2009: 208). Fighting was also a public activity for men that was accompanied by a set of rules utilised to prove their manliness and uphold their sense of honour (Shoemaker 2001, 2004).

Violent acts, while certainly more prevalent, were not limited to the men; the women would also engage in many forms of violent behaviour (Hurl-Eamon 2005; Shoemaker 2004). Individuals would tend to assault their own gender more so than the other, this being especially true with female assailants (Hurl-Eamon 2005: 70). Nonetheless, violent crimes against individuals were on the decline at the beginning of the 1800s (George 2000; Sheppard 1998; Shoemaker 2004; Travers 1997). Rather than engaging in violent behaviour, gentlemen, or men of the upper-classes, would make use of verbal insults as a way to defend their honour in public since physical displays were no longer the appropriate manner in which civilised individuals react to a personal affront (Shoemaker 2001, 2004). Even so, domestic violence, especially wife-beating, was still ever present in London during the eighteenth and nineteenth centuries (Beattie 1986; Carroll 2007; Shoemaker 2001, 2004; Travers 1997).

2.3.5.1 Violence against women

English society was patriarchal and as a result men were the heads of their respective households and to claim their superiority, chastisement of their wife, children and servants was seen as a man's fundamental right (Amussen 1994; Beattie 1986; Clark 1992; Doggett 1992; Hunt 1992; Meldrum 2000; Shoemaker 2004: 158; Travers 1997). In fact, a husband's legal right to beat his wife was detailed as early as 1516 in English legal manuals (Wood 2004: 63). While men were allowed to reprimand their wives within appropriate boundaries, women were also required by law to accept some degree of physical discipline from their husbands (Hurl-Eamon 2005: 56; Travers 1997: 101-102).

There is some evidence that violence towards women was present in all social circles. Unfortunately, little documentary evidence exists of domestic servants witnessing violence between their master and mistress (Meldrum 2000) so the actual extent of the presence of violence against women may be hard to uncover and fully understand. Furthermore, wife-beating was deemed a lower-class issue due to the assumed cruel and savage nature of working-class man and was ignored when it occurred in the upper classes (Beattie 1986: 124; Clark 1992; Travers 1997: 13). This classification came to light in order to strengthen the notion that elite men protected the women in their families and that elite women were safe within their household (Clark 1992: 191). Violence against wives garnered more attention in the 19th century (Clark 1992; Travers 1997) and it was said that men were restricted to strike their wives only with a stick no wider than their thumb (Amussen 1994: 70; Clark 1992: 191; Doggett 1992: 7; May 1978: 139). Finally, in 1891, England abolished the right to marital discipline (Carroll 2007: 26-27; Perciaccante et al. 1999: 761-762).

Summary

Bioarchaeological studies offer a different perspective when studying history and past populations. By utilising the vast amount of information that skeletal material can yield regarding numerous aspects of the lives of individuals of the past, it may be possible to present an alternative interpretation to the one given by historical accounts. Bioarchaeological studies are not immune to limitations; yet, their strength is derived from their interdisciplinary nature (Larsen 1997, 2002; Owens 2007: 467; Wright and Yoder 2003: 56).

The presence of healed fractures on the chosen skeletal material is at the core of this project. As such, an understanding of different fracture types and how they occur was presented in this chapter. Their healing process and how they can be identified was also described. Furthermore, five fracture types were recurrently identified as possible markers for interpersonal violence in the bioarchaeological and clinical literature and as such were reviewed in this chapter.

In order to provide a context for the fractures seen on the analysed skeletal material, an overview of the life of Londoners was presented. London has clearly gone through a lengthy and diverse transformation over the centuries due to migration and the subsequent population growth. Also, the lifestyles of the rich as well as the poor were explored in order to better understand the different social problems encountered by each. All these social concerns can very well have had an influence on people's behaviour, which in turn generated a need to explore the presence of violence in London within these different social and economic contexts.

In the following chapter, the research aims and methods behind the research will be explored. Furthermore, more detailed information regarding each of the skeletal collections utilised for this study can be found.

Chapter 3
Research aims, materials and methods

The aims and objectives of the research carried out on skeletal remains from burial grounds found in London, and in use during the eighteenth and nineteenth centuries are found within this chapter. Based on the information gathered during the background research, this chapter will also present hypotheses that will focus on fracture patterns and the possible presence of interpersonal violence seen within the chosen burial grounds.

Once the objectives of the research have been laid out, a more concise and precise portrayal of the burial grounds analysed for this project will be drawn. This will permit the results from each collection to be cross-compared which will in turn reveal possible fracture patterns seen in 18th- and 19th-century London. Six skeletal collections, from various areas of London and dated to be between 1750 and 1850, were utilised; and, in order to properly interpret the fracture patterns seen within each collection and within the collective sample, a thoroughly detailed background on each individual site is necessary. The lifestyles, as well as the social and economic climates, for each community will be illustrated in order to understand the real differences faced by the residents exhumed from the burial grounds and how those differences may have affected the presence of violence in their lives.

The section focusing on the materials used during the research continues by explaining a number of limitations that were encountered, as well as the database used to collect the information. Afterwards, the methods behind the research are explored, such as determining the individuals' biological profiles as well as the process to determine the presence of ante-mortem fractures and how they were characterised anatomically. Finally, the types of statistical tests utilised and conducted for this study, in order to appropriately answer the questions that have emerged from the investigation of the available historical references, will be examined.

3.1 Research aims and objectives

The research aims to acquire a better understanding and comprehension of the presence of interpersonal violence, and the subsequently associated fracture patterns, seen in London during the eighteenth and nineteenth centuries, due to a number of additional stresses imposed on London's population described in Chapter 2.

3.1.1 Aims and Objectives

The primary aim of the research strives to answer questions that have emerged based on the background information presented in Chapter 2. As such, are there fracture patterns displayed amongst the residents of 18th- and 19th-century London? Do they expose a propensity towards interpersonal violence amongst the population or simply an inclination towards accidental fractures? Do they expose a higher tendency of violence against women as opposed to the depiction presented in the literature? Furthermore, in order to achieve that aim, a secondary objective looks to gain an enriched understanding of fracture aetiology as some fracture mechanisms can be difficult to identify and easily misconstrued. Consequently, being able to properly identify the aetiology of the fractures found in the skeletal material will be a great help to the project.

Once the fractures have been identified and their features notated, an in-depth analysis of the aforementioned primary aim can commence. That analysis was done by observing the fracture patterns that emerged from the collective sample and from each skeletal collection. Afterward, these patterns can be cross-compared according to each skeletal collection which, in turn, came from various social and economic contexts found within London. As aforementioned in section 2.1 of Chapter 2, it is important to look at a population as a whole in order to be able to formulate the most accurate interpretation of the residents' living conditions and their corresponding possible exposure to violent incidents.

Ultimately, the data that has been collected from the six sites utilised in the current project will be used with the intention of determining if there is a type of fracture that is more common than another within the collective sample, and whether or not that alters when the sample is classified according to the individual collections, and then subsequently divided by sex and age. Furthermore, the possibility of some individuals being injury recidivists by suffering multiple fractures will add to the assessment with reference to the possible presence of abuse. On the other hand, in some cases, injury recidivism could also indicate a person's proximity to more perilous work conditions, or an accident-prone nature, which once again emphasises the utmost importance of the knowledge gathered on fracture aetiology and the context of the burial grounds. Finally, the data will expectantly elucidate the possibility that fractures possibly due to interpersonal violence are more prominent in certain social situations and circumstances as opposed to others. These additional objectives will complete the research aims that have been mentioned above and will give a bioarchaeological approach, analysis and representation of the presence of violence in London during the eighteenth and nineteenth centuries.

3.1.2 Research hypotheses

The aims and objectives of the research are but a part of what the current thesis intends to define. In order to focus the research, the hypotheses formulated below will consider the presence of incidents of violence within London and more precisely, the six communities that were chosen for analysis. The hypotheses will express more clearly some of the aims and objectives mentioned above so that the statistical tests performed on the data can be better organised.

3.1.2.1 The male skeletons will have more fractures

The first hypothesis stipulates that, in general, men will have suffered more fractures throughout their lifetime compared to their female counterparts. Based on the historical background, it would seem that men ran the risk of being subjected to more incidents of either interpersonal violence or accidental in nature, which could manifest in the form of more fractures on the male skeletons than the ones identified as female.

3.1.2.2 The male skeletons will have more fractures due to interpersonal violence

Consequently, not only will the males have more fractures than the female skeletons, they will also suffer more fractures that are commonly associated with incidents of interpersonal violence. This is supported by the literature as men have a higher tendency than women to resort to physical violence in order to settle disputes (Carroll 2007: 15; Shoemaker 2004: 168; Wiener 1998: 198-199; Wood 2004: 25). Women would be more exposed to violence at the hands of their husbands (i.e. wife-beating), which is the subject of the next hypothesis.

3.1.2.3 Wife-beating is present in all socioeconomic contexts

To the view of many individuals during these centuries, what happened within a household was protected by the private sphere (Doggett 1992: 57; Wood 2004: 61) and it was deemed separate from the state (Clark 1992: 191-192). As a result, any domestic disputes were often marginalised as a husband's right to chastise not only his wife, but also his children and servants (Hurl-Eamon 2005: 65; May 1978; Wood 2004: 61). As a result, this hypothesis states that violence against women was present in all social and economic contexts. However, mirroring the next hypothesis, its prevalence would be directly correlated with the social and economic situation of the population; for that reason, it would be more prevalent in the poorer populations.

3.1.2.4 The poor populations will have more fractures than the wealthy

This hypothesis stipulates that not only will the poorer populations have suffered more fractures in general, but they will also have a higher number of fractures due to interpersonal violence when compared to individuals from more affluent communities. As previously mentioned in section 2.3.5 of Chapter 2, by the beginning of the nineteenth century, the gentry encouraged behaviour that was civil and courteous, which was characterized as acceptable and honourable, rather than promoting violence to uphold honour. On the other hand, the lower-classes were still being characterised as individuals who displayed behaviour much more barbaric and savage. Accordingly, this hypothesis stipulates that the individuals from Chelsea and Kingston will present fewer fractures than those from St Benet, St Bride and Cross Bones when compared statistically.

3.1.2.5 Older individuals will have more fractures

Both anthropologically and epidemiologically speaking, an older individual will have been subjected to more life experiences which include the higher possibility of exposure to violence and of fractures by simply having lived longer than a younger individual (Larsen 1997: 118; Mays 1998: 176; Roberts 2000: 345). Furthermore, they would encounter more possible risks simply by having frequented the, at times, hazardous streets of London where crowds, accidents, protests, insults and violence were always a present factor (Shoemaker 2004: 21), more often than younger individuals. Even with the fact that violence in England was on the decline during the centuries of interest, this hypothesis stipulates that older individuals will have suffered more fractures, either due to accidents or interpersonal violence, than the younger individuals in the collective sample and in each individual collection.

3.2 Skeletal material

Six skeletal collections were chosen for research as they display a variety of social and economic contexts seen throughout post-medieval London. Below is a description for each of the burial grounds. The location, dates of use and the socioeconomic context of the burial grounds are provided in order to place these collections within a specific time and place. In order to properly interpret what the skeletal lesions demonstrate, one must have a clear understanding of the lives led by the individuals interred within these burials grounds. Figure 3.1 displays the City's and its boroughs' geographical boundaries in 1851 where the lines are highlighted in either blue, pink or yellow. While these borders were recorded ever so slightly after the years of use of the burial grounds, 1750-1850, it does allow for a better visualisation regarding the size of each area towards the end of the period of interest. The numbers inserted into Figure 3.1 display the approximate geographical location of each of the burial grounds used in this study with the exception of the burial ground from Kingston-Upon-Thames. This particular burial ground falls beyond the scope of Figure 3.1 but is located to the south-west of Chelsea, as seen in Figure 3.2.

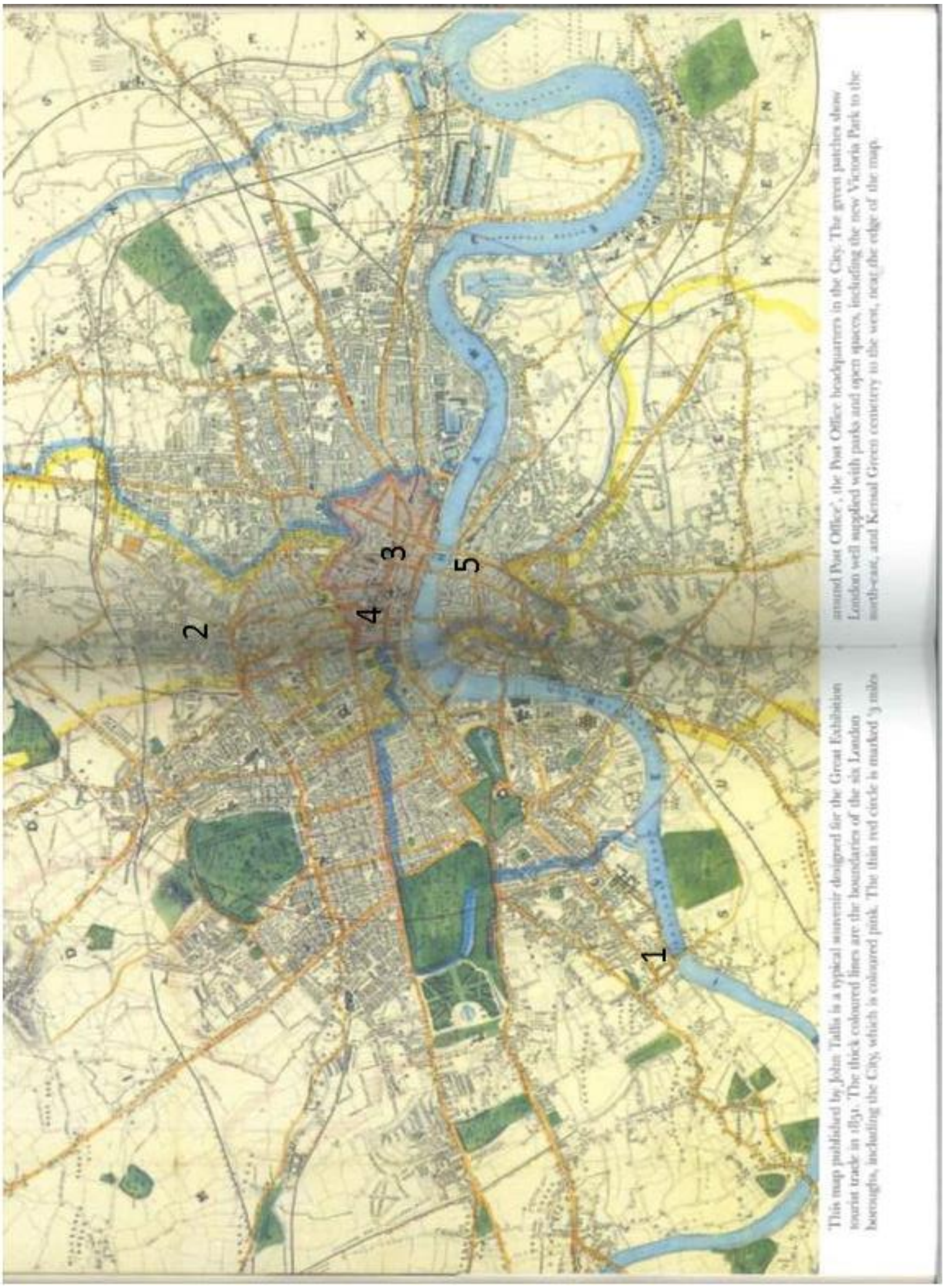


Figure 3.1 - Map of 1851 London originally published by John Tallis (Picard 2006). The numbers represent the individual burial grounds and are as follows: (1) Chelsea Old Church, (2) Bowling Green Lane, (3) St Benet Sherehog, (4) St Bride's Lower Churchyard, and (5) Cross Bones.

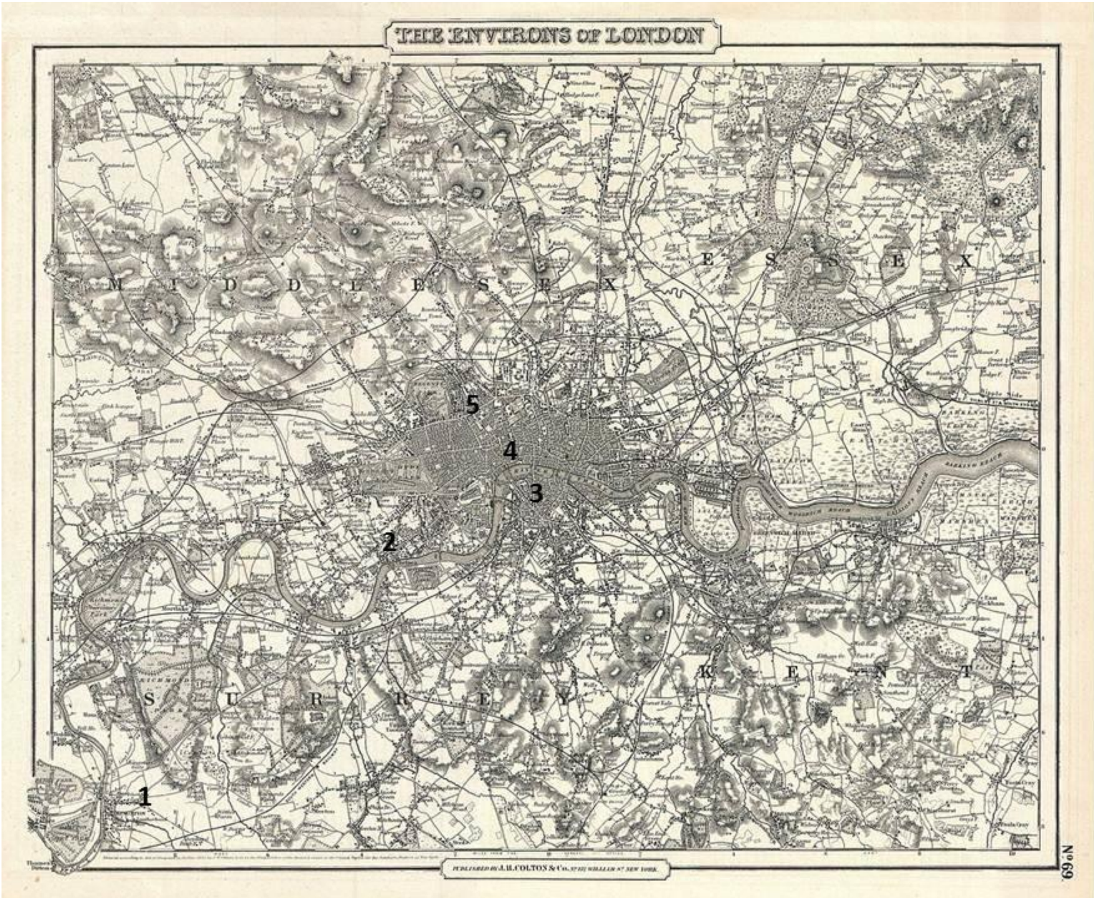


Figure 3.2 - Map of 1855 London (Colton 1855). The numbers represent the boroughs where the burial grounds are located and are as follows: (1) Kingston-Upon-Thames, (2) Chelsea, (3) Southwark, (4) The City, and (5) Clerkenwell.

3.2.1 Chelsea Old Church

Originally, Chelsea was a quaint and tranquil little village on the Thames near London (Borer 1973; Denny 1997; Holme 1972; Lysons 1795; Walker and Jackson 1987). However, once Henry VIII proclaimed his preference for this village is quickly began to grow and expand (Russett 2004: 28).

3.2.1.1 The Village of Palaces

In 1724, Daniel Defoe labelled Chelsea "The Village of Palaces" due to the number of stately manors constructed on the riverbank as well as the number of members of the royal family having lived there during the Tudor reign (Borer

1973: 1-2; Davies 1904: 36; Denny 1997: 8; Russett 2004: 80; Walker and Jackson 1987: 111). As such, the area's popularity grew with royal officials as well as courtiers and continued to grow during the 18th and 19th centuries. It would also become a fashionable area due to the number of artists and writers who had settled there, and as a result of this new status, Chelsea attracted many of London's wealthy residents, merchants, bankers and lawyers (Holme 1972: 127; Walker and Jackson 1987: 118-119). Chelsea would be lauded as an escape from city life with the opportunity to return to London rather quickly thanks to the Thames (Godfrey 1909; Thorold 1999: 68; Walford 1878a; Walker and Jackson 1987: 111).

By the beginning of the nineteenth century, Chelsea was no longer a village due to its growing population as a result of the popularity of the area. By 1800, the population had reached twelve thousand residents (Borer 1973: 192; Croot 2004; Russett 2004: 110). According to the 1811 census it had further augmented to 18,262 (Croot 2004; Thorold 1999: 181) and Chelsea's population eventually reached 53,725 residents by 1851 (Croot 2004). Yet, there was still a very large acreage of open land that was being cultivated in the early 1800s. During the first two decades of the century, there were approximately 275 families who cultivated the lands. However, as the area became more and more fashionable and the social landscape changed, that number dwindled down to 87 in the following ten years (Walker and Jackson 1987: 153). Nonetheless, Chelsea retained its charming village atmosphere.

3.2.1.2 The Old Church

The parish church was once known by the names of All Saints as well as St Luke's prior to affectionately becoming known as the Old Church in the 1800s (Denny 1997: 21; Holme 1972: 43; Russett 2004; Walker and Jackson 1987: 120).

The northern part of the Chelsea burial ground, located at 2-4 Old Church Street, was in use from 1712 to 1842 (Cowie et al. 2008: xi; Kausmally 2008a).

The parish was wealthy due to its affluent parishioners and remained so during the cemetery's use (Cowie et al. 2008; Denny 1997: 55). Along with the excavated skeletal remains, an excavation of 6-16 Old Church Street revealed affluent materials which also suggest that the individuals interred within the area were of middle to high socio-economic status (Farid 2000: 135). For example, some the artefacts found within the burial ground located at 2-4 Old Church Street include, but are not limited to: a complete ceramic wig curler with a stamped 'WB' and crown on each end, a gold-coloured ring, coffin upholstery studs either in an copper alloy or an enamelled iron, the remains of an ivory-handled iron whittle knife, and pieces of finer textiles such as velvet and silk (Cowie et al. 2008). While the artefacts were not very well preserved, they do reflect possessions and burial customs that wealthy patrons could afford (Cowie et al. 2008) and would undoubtedly be out of reach for the poorer individuals living in Chelsea. Some of the exhumed individuals are associated with biological information such as name, date of birth and date of death which was found on tombstones or nameplates.

The excavation of the site of Chelsea Old Church was undertaken prior to further development on the site (Kausmally 2008a). The churchyard was originally excavated as a single evaluation trench and burials were thought to have all been removed in the 1960s prior to the construction of a new church hall. Nonetheless, the evaluation trench revealed burials located near the north wall of the churchyard's wall (Cowie et al. 2008: 1).

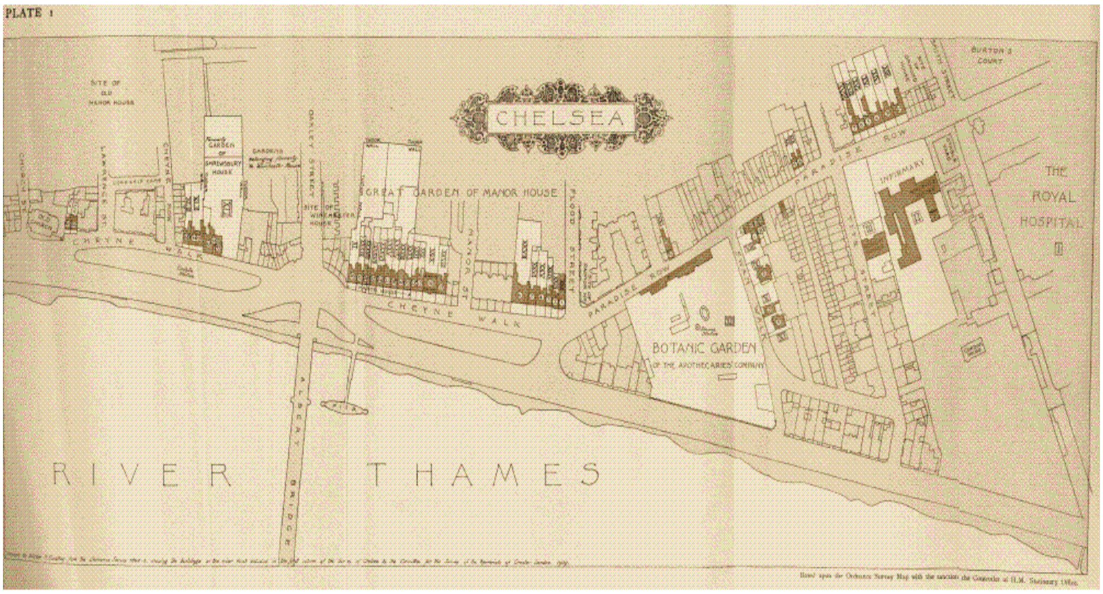


Figure 3.3 - Map of Chelsea, from the Royal Hospital to the Old Church based on the Ordnance Survey (1894–6) (Godfrey 1909).

3.2.1.3 Chelsea Old Church [OCU00]

The excavations carried out at this burial ground revealed 290 burials, and 198 of the exhumed individuals were analysed by the MoL CHB (Bekvalac and Kausmally 2008; Kausmally 2008a). During the laboratory work conducted for the current project, 165 adult skeletons were available for analysis. Within the group of adult skeletons, 90 individuals were male, 55 were female and 20 were unsexed (Figure 3.4). A description of the methods used for determining the sex of the individuals can be found below in section 3.4.1.1.

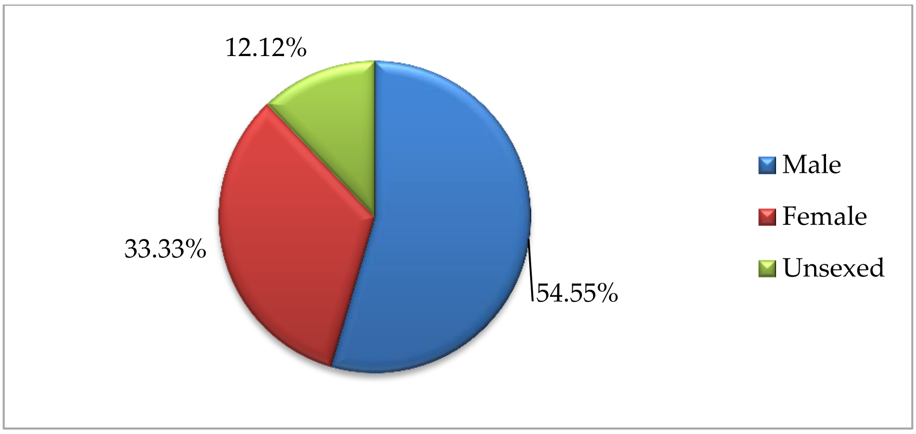


Figure 3.4 - Sex distribution for the individuals from Chelsea Old Church.

When the age was estimated, it was found that: 49 individuals were young adults (YA), 43 were middle adults (MA), 43 were old adults (OA) and 30 were of indeterminate age (Figure 3.5). Lastly, fractures were exhibited by 37 individuals in this collection. Henceforth, the collection will be referred to as Chelsea in the text. A description for the methods used for estimating the age of the individuals can be found below in section 3.4.1.2.

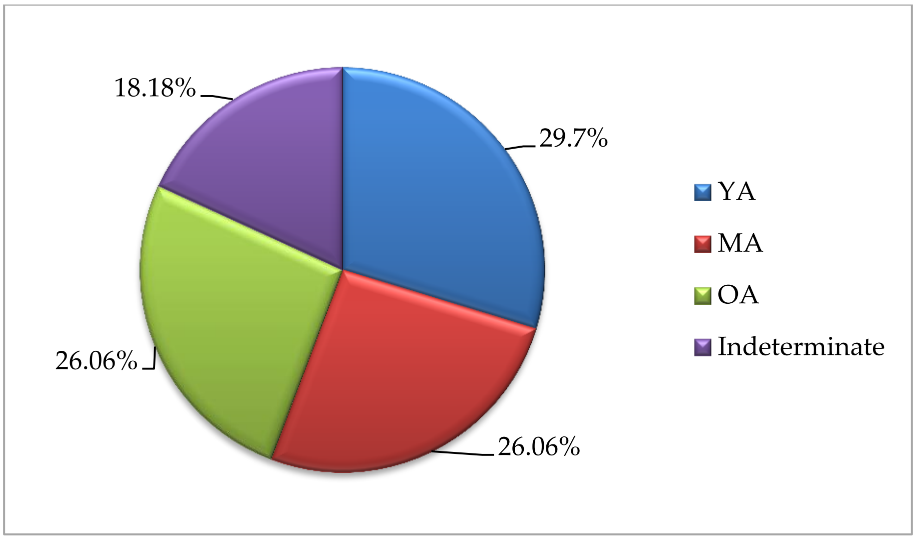


Figure 3.5 - Age distribution for the individuals from Chelsea Old Church.

3.2.2 Kingston-Upon-Thames

As mentioned above, the Royal Borough of Kingston-Upon-Thames is located south-west of Chelsea and approximately eleven miles from Westminster Bridge (Lysons 1792). During the eighteenth and nineteenth centuries, it was still far enough away from London so that it was not yet included within its surrounding boroughs. As the other five burial grounds are located very close to or within the City, this burial ground gives an excellent opportunity to explore the presence of violence in a much more rural setting. Furthermore, its religious affiliations differ from what is seen with the other burial grounds.

3.2.2.1 The Religious Society of Friends (Quakers)

Kingston-Upon-Thames has a long history with non-conformist communities, with the longest affiliation belonging to the Quakers (Lysons 1792; Sampson 1997: 28). However, because of Conventicle Acts, which passed in 1664 and 1670, worshiping elsewhere than inside the parish church was forbidden by law; as a result, members of the Religious Society of Friends would meet in secret (Pulford 1973: 3; Sampson 1997: 28-29). Many Quakers suffered abuse at the hands of other residents, as well as soldiers, based on their religious beliefs alone (Sampson 1997: 28-29). One could infer that this resulted in members avoiding any confrontations for fear of repercussions and inadvertently unveiling their beliefs and illegal assemblies. Furthermore, rather than feeling obliged to accept a challenge, which would inevitably end with violence, men from the Religious Society of Friends would feel no need to acknowledge such behaviour (Bayne-Powell 1937: 48). King William III's Tolerance Act was established in 1689 and put an end to the need for secret meetings (Pulford 1973: 6). Be that as it may, it is probable that the Quakers were still targeted because of their non-conformists beliefs.

As for its industries, many breweries were located in Kingston-Upon-Thames (Sampson 1997: 44) which inevitably brought with it the repercussions and vices of pub life: drunkenness, debauchery, idleness and extravagance. Violence was also a resultant factor, and punishment in Kingston was very fierce where public humiliation was a very large component of that reprimand (Sampson 1997: 37). The Quakers however, were much more interested in living a sober life as well as helping and supporting the poor (Bashford and Sibun 2007: 107; Pulford 1973). If a Friend was in need, another member would lend them money in order to provide relief. There is also evidence in their documents that they would raise money for a specific individual or cause (Pulford 1973: 23).

3.2.2.2 The burial ground at 84 London Road

The land at 84 London Road, Kingston-Upon-Thames was purchased by members of the Quaker community during the 17th century with the intent of establishing a burial ground for the Religious Society of Friends (Bashford and Sibun 2007: 102). The Kingston burial ground was inaugurated in 1664 and utilised until 1814; it fell out of use after that date and a replacement was sought (Bashford and Pollard 1998: 155). Unlike the overflowing burial grounds found in London (see section 2.3.1.2 of Chapter 2), the common practice among Quakers was for singular burials rather than multiple interments in one grave plot (Picard 2006: 369).

During the excavation, the preservation of burial artefacts was not excellent; yet, a pair of gold-plated copper-alloy cufflinks set with a green glass were found (Bashford and Sibun 2007: 131). Furthermore, some richer textiles, such as velvet and leather, as well as upholstery studs featuring the deceased's initials, and date of death, were found (Bashford and Sibun 2007). Overall, the burial customs seen in this Quaker burial ground seems to follow their religious doctrine of simplicity (Bashford and Sibun 2007: 121); yet, these burials can nonetheless be classified as being from a community with a higher socio-economic status, principally due to their sober non-extravagant lifestyle indoctrinated by their beliefs. Some of the exhumed individuals are associated with biological information such as name, date of birth and date of death which was found on tombstones or nameplates; however, the number of such instances is limited as most of the burials were anonymous (Bashford and Sibun 2007: 141). Prior to the excavation, the burial ground had become a vacant lot which had been chosen as the site for the construction of residential developments.

Consequently, all human remains were exhumed in preparation for construction (Bashford and Pollard 1998: 154).

3.2.2.3 Kingston-Upon-Thames [QBK96]

During the autumn of 1996, excavations revealed 364 of the 497 documented interments for this burial ground. Most of the exhumed burials were returned to the present Quaker community for reburial (Bashford and Pollard 1998; Bashford and Sibun 2007). Forty-eight of the exhumed skeletons were kept for research purposes by Bournemouth University (BU) and of that number, 42 adult individuals were analysed for this project. In this collection, there are 23 males, 17 females and two unsexed adults (Figure 3.6).

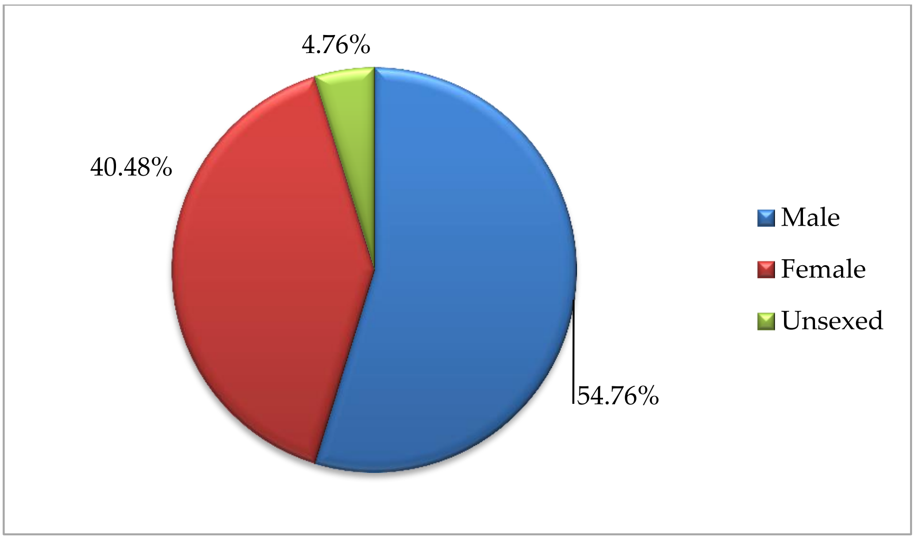


Figure 3.6 - Sex distribution for the individuals from Kingston-Upon-Thames.

As for the age categories, there are six YA, ten MA, 18 OA and eight indeterminate adults (Figure 3.7). This collection has the least amount of individuals with a fracture as only ten skeletons were found to exhibit one or more fractures. When this particular burial ground is mentioned in the text, it will be designated as simply Kingston.

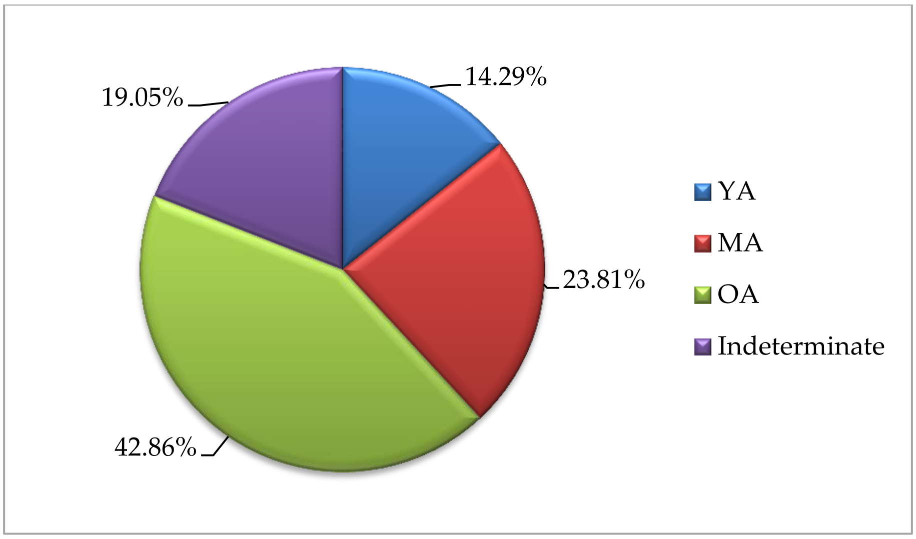


Figure 3.7 - Age distribution for the individuals from Kingston-Upon-Thames.

3.2.3 Bowling Green Lane

This particular burial ground is located in the northern London neighbourhood of Clerkenwell on Bowling Green Lane.

3.2.3.1 Lawn bowling and watch-makers

Prior to the Great Fire, this area was occupied by the grand stately mansions of the nobility and gentry (Pinks and Wood 2001: 10; Walford 1878b). The name of the lane depicts one of the bourgeois activities, and favourite sports, which entertained many of the residents in this area of London. The lane was also named as such due to the many bowling-greens that were found in the area (Pinks and Wood 2001: 89; Thornbury 1878). During the 1700s, the principal industry in the area was watch and clock-making, as well as other items of very-high craftsmanship such as jewellery (Booth 1969: 191; Green 1995: 156-157; Thornbury 1878). This area had been primarily occupied by domestic workshops but began to be industrialised during the 18^{th} and 19^{th} centuries (Sheppard 1998); as a result, many of the craftsmen became unemployed as a direct consequence and their fortunes were very quickly depleted (Green 1995: 156). Therefore, Clerkenwell became less fashionable as the rich continued their exodus towards the West End (Black 2009) in order to reside in other areas while poorer individuals, who worked primarily outside this area, began inhabiting the abandoned houses (Booth 1969: 191).

3.2.3.2 The burial ground at 10 Bowling Green Lane

This burial ground is located at 10 Bowling Green Lane, which is on the corner of this street and Rosoman Street, and is associated with the parish of St. James' Church (Bard 2008: 93; Holmes 1896: 288). It was designated as an overflow cemetery and as a result, was some distance from the parish church. Holmes (1896: 110, 288) describes this burial ground as being a 'middle ground' for the St James parish, just like other parishes had 'poor grounds'. As a result, both wealthy and poor individuals were interred within Bowling Green Lane which also reflects the aforementioned changes seen in the neighbourhood during the two centuries of interest (Ives and Melikian 2009: 16). This is also reflected in the excavated artefacts where the poorer individuals had coffins with few decorations while the wealthier individuals had coffins that were quite elaborately decorated (Ives and Melikian 2009: 16). The burial ground was in use from the 1600s to 1853 (Bard 2008: 93) while the burials were dated to be between 1775 to the mid-1800s as per the dates of the lease for the burial ground. Finally, this site was also excavated prior to redevelopment of the area (Ives and Melikian 2009: 15).

3.2.3.3 Bowling Green Lane [BGQ06]

The excavations of this burial ground took place during 2006-2007. During these excavations, close to 3000 individuals were exhumed, while only 689 were retained for analysis (Ives and Melikian 2009) by the AOC Archaeology Group (AOC). Only the individuals with a fracture are found in the database created for this thesis which involves 135 individuals. Further information on the limitation encountered with the collection from Bowling Green Lane is found below in section 3.3.1.2. However, Figure 3.8 presents the sex distribution on the total number of adult individuals in the collection as the additional information was provided in a publication (Ives and Melikian 2009). As a result, there are 492 adults in this skeletal collection with 292 individuals being males, 159 being females and 41 unsexed adults.

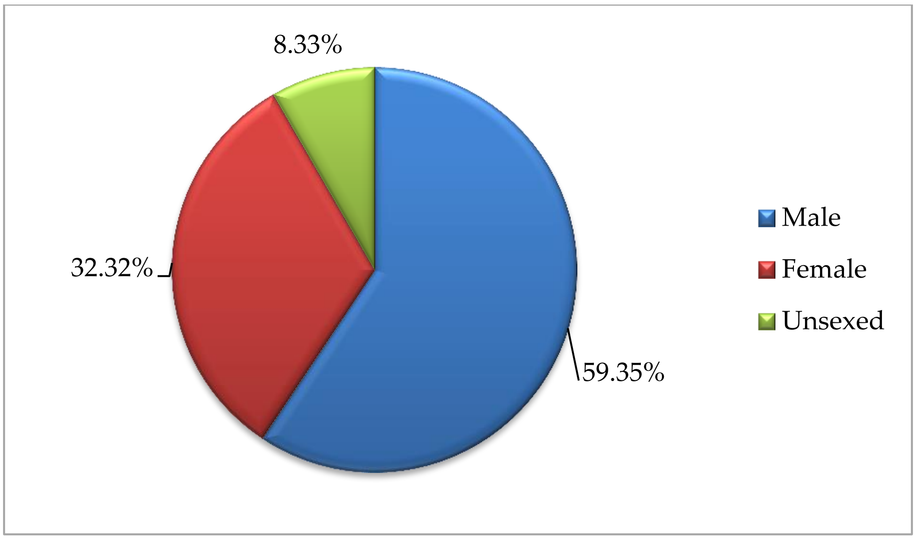


Figure 3.8 - Sex distribution for the individuals from Bowling Green Lane.

As for the age categories, the available information does not pertain to the individuals without a fracture within this population. Unfortunately, the published material referenced above presenting the sex distribution in the sample from Bowling Green Lane did not include the information regarding the age distribution of the adult skeletons. However, age estimation was carried out on the individuals who were analysed and do exhibit a fracture (Figure 3.9). Within that group of individuals exhibiting a fracture, 32 are YA, 73 are MA, nine are OA and 21 are indeterminate adults. There are 135 individuals with a fracture within this collection, which is the highest number of individuals with a fracture within the six collections that were analysed. This particular collection will also be identified as BGL over the course of this thesis.

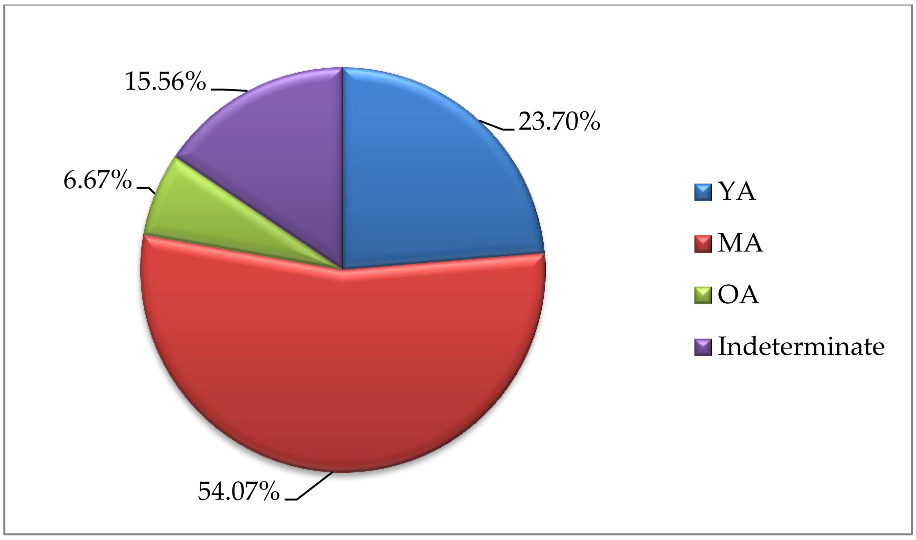


Figure 3.9 - Age distribution for the individuals exhibiting fractures from Bowling Green Lane.

3.2.4 St Benet Sherehog

The parish of St Benet was a very small parish and one of the smallest found within the boundaries of the City of London (Miles et al. 2008: 3). The parish is situated within Walbrook Ward, one of many self-governing units located in the heart of the City, and also encompasses Mansion House, the lord mayor's residence (Noorthouck 1773). The original St Benet Sherehog church had been in use since the 11th century and unfortunately was one of the 87 destroyed during the Great Fire (Black 2009: 138-139; Rowsome 2000: 69; Sheppard 1998: 183). Following the reorganisations of the parishes in 1670, the small parish of St Benet Sherehog was merged with that of St Stephen Walbrook (Miles et al. 2008: 4; Noorthouck 1773; Rowsome 2000: 69). St Stephen's church is located behind the north east corner of Mansion House (Noorthouck 1773). Afterward, the site of the original church of St Benet Sherehog became its namesake's burial ground which was in use until 1853 (Cowal 2008; Miles et al. 2008: 4; Rowsome 2000: 69).

3.2.4.1 Life in Walbrook Ward

Prior to the Great Fire, the central areas of the City were occupied by wealthy individuals, especially near Cheapside (Sheppard 1998: 172) which extends to Poultry Street, the location of the burial ground. During the following centuries, the core of the City became a domestic and international business nucleus, especially for banking and insurance (Sheppard 1998: 205) as many rich businessmen, merchants and shopkeepers decided to rebuild after the fire and continue to live within the old City walls (Bayne-Powell 1937: 11; Richardson 1995: 98; Thorold 1999: 18). However, poor individuals were also found within the parish as their hovels were discovered among the mansions of the wealthy individuals (Denny 1997: 8; Green 1995: 186). The poor would remain in the area in order to serve their wealthier employers due to the expensive cost of transportation (Earle 1989: 205).

3.2.4.2 The burial ground at 1 Poultry Street

The burial ground for the parish of St Benet Sherehog is located at 1 Poultry Street, City of London. The parish itself was found to be very affluent based on the evidence gathered from wills and the high scores it received in a number of measures of wealth during the 16^{th} and 17^{th} centuries (Miles et al. 2008: 13). Immediately after the Great Fire, some wealthy individuals were buried within the newly minted burial ground. However, the wealthy would mostly choose to be laid to rest in St Stephen's vault and as a result, this burial ground is mostly a resting place of the poor and pauper individuals of the small parish (Miles et al. 2008: 53; Rowsome 2000: 69). The excavation yielded individuals who were dated to be between 1770 and 1849 (Miles et al. 2008: 5). The preservation of the coffins and artefacts was very poor. Of the very small amount of textiles that were found, they were quite a rough cloth (Miles et al. 2008: 60) as opposed to the finer and more expensive textiles found in some of the previously described burial grounds. As for other artefacts, corroded shroud pins, coffin nails and copper-alloy buttons were mostly found (Miles et al. 2008). Furthermore, some of the nails were found to be imbedded into bone, which suggests that the coffins were too small and the bones accidentally pierced (Miles et al. 2008: 67). It seems unlikely that those with the financial means would purchase a coffin too small for the individual being buried within. As a result, the artefacts found during the excavation also suggest that this burial ground was for poor parishioners. Some of the exhumed individuals are associated with biological information such as name, date of birth and date of death which was found on tombstones or nameplates. This excavation was carried out in conjunction with the construction of a new office building on the site. While the new structure was being erected, the excavations took place in what became the basement levels of the building (Rowsome 2000: 6).

3.2.4.3 St Benet Sherehog [ONE94]

The burial ground of St Benet Sherehog was excavated during 1994-1996 and 274 individuals were exhumed. A few burials were dated to be medieval, but 235 individuals were dated as post-medieval burials (Cowal 2008; Rowsome 2000). MoL CHB has analysed and curated 231 post-medieval individuals. During the laboratory work carried out for this thesis, 162 adult individuals from St Benet were available for analysis. Within that group of adults, there are 83 males, 39 females and 40 individuals of unknown sex (Figure 3.10).

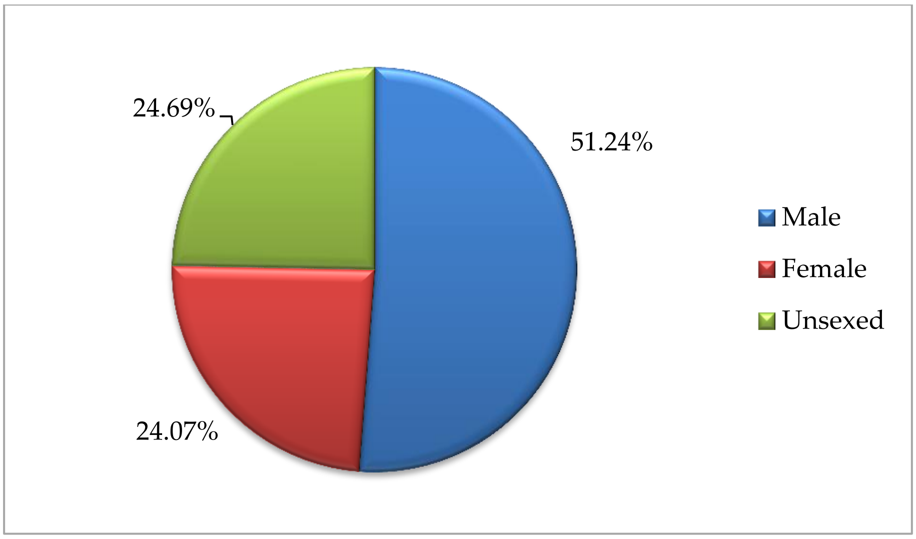


Figure 3.10 - Sex distribution for the individuals from St Benet Sherehog.

When the age categories were explored, it was found that there were 56 YA, 38 MA, 18 OA and 50 indeterminate adults (Figure 3.11). Lastly, only 17 of the individuals analysed from this collection have suffered a fracture in their lifetime. Hereafter, this collection will be identified as St Benet in the text.

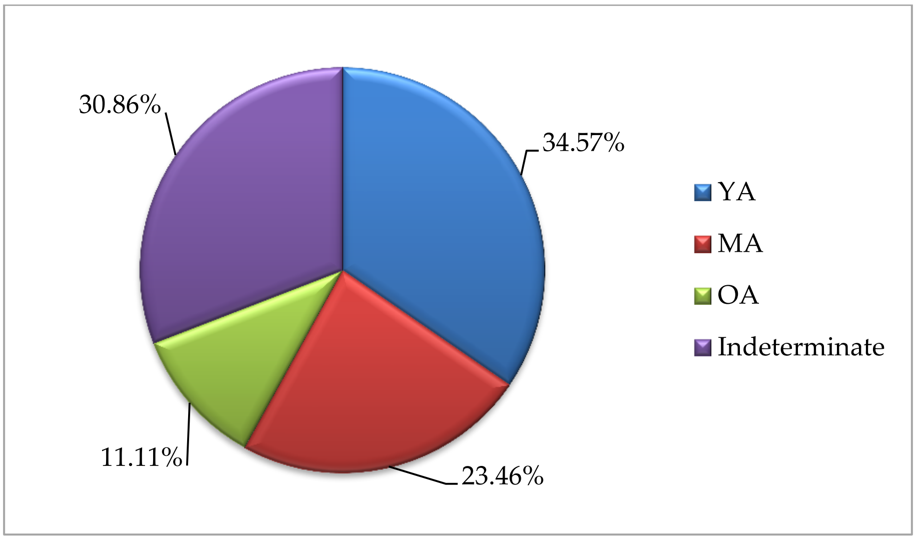


Figure 3.11 - Age distribution for the individuals from St Benet Sherehog.

3.2.5 St Bride's Lower Churchyard

The church of St Bride is located on Fleet Street, which resides within the City of London, and the original church was destroyed by the Great Fire. It was rebuilt by Sir Christopher Wren and re-opened in December of 1675 (Milne 1997: 6; Morgan 1973). This particular parish is found in the ward of Farringdon Without (Figure 3.12), not to be confused with the ward of Farringdon Within which lies inside the boundaries of the ancient roman walls (Noorthouck 1773). Farringdon Without is the largest ward found within the City and lies on the periphery of the original roman London wall (Thornbury 1878). The social and economic situation found within this parish resembles the circumstances found within Walbrook Ward.

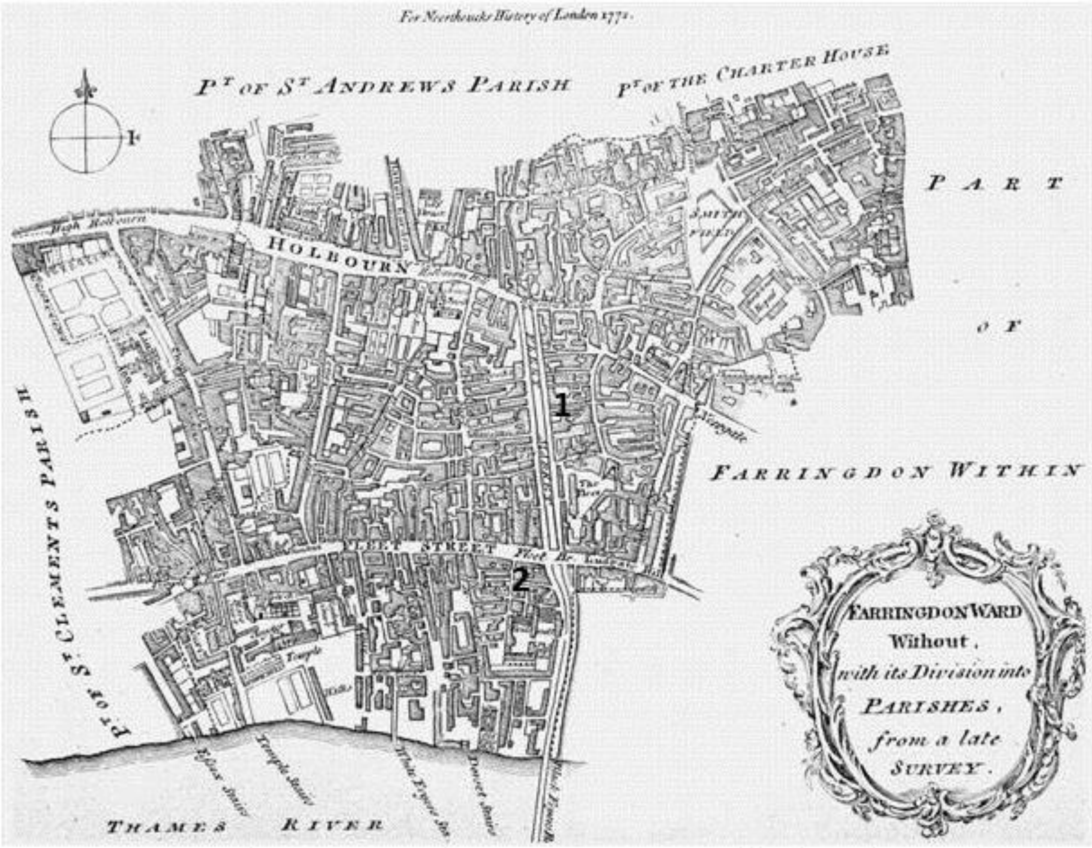


Figure 3.12 - Plan of the ward of Farringdon Without (Noorthouck 1773) displaying the approximate location of the (1) Lower Churchyard and the approximate location of (2) St Bride's Church.

3.2.5.1 Life in Farringdon Without

Originally, Fleet Street was a stomping ground for the wealthy individuals of the City where theatres were found and concerts given (Morgan 1973: 91-92). This area was the home of a considerable populace of gentry and nobility (Harding 1998: 57). Additionally, this particular ward was also known for its banking connections (Thornbury 1878). Nonetheless, there were just as many poor and working class individuals, such as tradesmen, printers and merchants found within the boundaries of Farringdon Without (Morgan 1973: 91-92). In the early 1700s, the area off Farringdon Street became a popular spot for pugilism and baiting (Richardson 1995: 117). Additionally, this area was the home of Bridewell, a workhouse and lower end prison, as well as the Fleet Street prison which incarcerated debtors (Bayne-Powell 1937: 214; Hitchcock 2004: 162; Noorthouck 1773; Picard 2006: 335; Thornbury 1878). The council appointed alderman representing the ward in 1769, whom happened to be very popular with a large number of people was John Wilkes, a known criminal of the state with violent tendencies (Thornbury 1878).

3.2.5.2 The Lower Churchyard on Farringdon Street

In 1610, St Bride's Church opened and consecrated the Lower Churchyard burial ground (Bard 2008: 37) located at 75-82 Farringdon Street, City of London. This land was donated by the Earl of Dorset (Bard 2008: 37; Holmes 1896: 84-85) in order to stop the interments occurring in the burial ground located around the church on Fleet Street, incidentally near his home, as it had become very unsightly and malodorous (Holmes 1896: 84-85; Morgan 1973: 91). This overflow cemetery was utilised by the poorer population of the parish due to the Lower Churchyard having the least expensive burial costs compared to the other burial sites associated with the parish (Holmes 1896: 181; Miles and Conheeney 2005: 73). There were no tombstones or markers of graves (Bard 2008: 37;

Holmes 1896: 319) which reflects the low cost burials. Furthermore, only 31.4% of the excavated coffins presented any degree of decoration (Brickley et al. 1999: 26). Records also show that a considerable number of individuals from the Bridewell workhouse as well as 41 prisoners from the Fleet Street prison were buried within the Lower Churchyard (Miles and Conheeney 2005: 75-78; Werner 1998: 90); and, that over 95% of the individuals interred within the Lower Churchyard resided in the parish of St Bride's at the time of their death (Miles and Conheeney 2005: 83). The burials were dated to be between 1750 and 1849 (Miles and Conheeney 2005: 83). The excavation was also done in advance of redevelopment (Miles and Conheeney 2005: 20).

3.2.5.3 St Bride's Lower Churchyard [FAO90]

During the excavations beginning in 1990, 606 individuals were exhumed and 544 were retained for analysis (Kausmally 2008b) by MoL CHB; however, it is believed that between 5000 and 8000 individuals were laid to rest in the lower churchyard (Miles and Conheeney 2005: 83). This collection is by far the largest that has been analysed for the current project as a total of 362 adult individuals were studied. Within that number, 210 individuals are male, 114 are female and only 38 are of unknown sex (Figure 3.13).

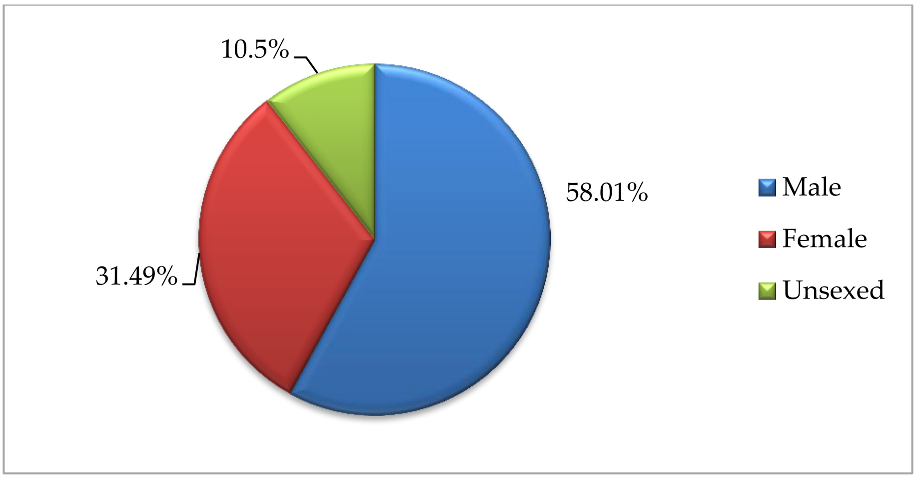


Figure 3.13 - Sex distribution for the individuals from St Bride's Lower Churchyard.

The age categories revealed 76 YA individuals, 118 MA, 75 OA and 93 indeterminate adults (Figure 3.14). Furthermore, St Bride's Lower Churchyard has the second highest number of individuals with a fracture after Bowling Green Lane (n = 135). Of the individuals buried within this particular churchyard, 133 exhibited a fracture. Over the course of this and subsequent chapters, the burial ground from the Lower Churchyard will be identified as St Bride.

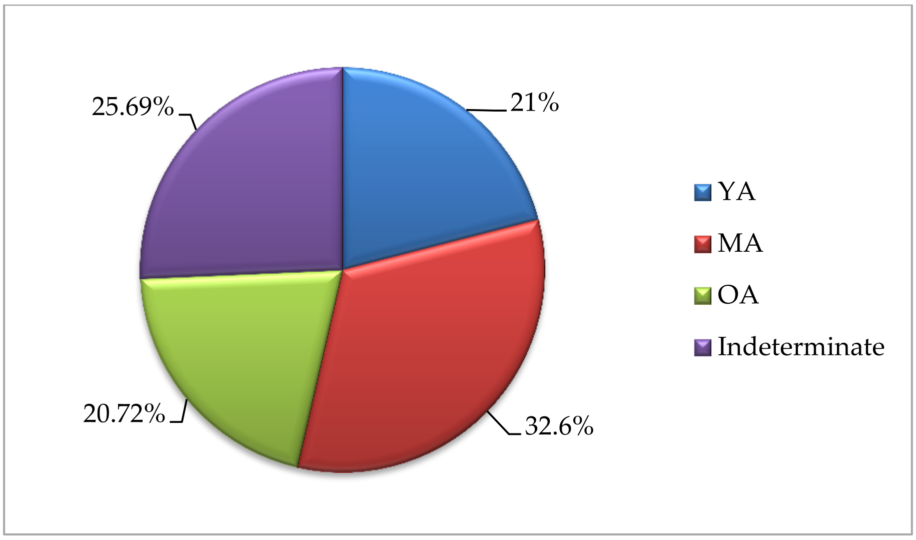


Figure 3.14 - Age distribution for the individuals from St Bride's Lower Churchyard.

3.2.6 Cross Bones

The South Bank of the Thames escaped the ravages of the Great Fire but reaped the consequences when a large influx of individuals arrived (Higham 1955: 206). Once the bridges traversing the Thames were built, especially London Bridge which acted as a thoroughfare, Southwark became more and more occupied and crowded (Higham 1955: 231; Malden 1912; Reilly and Southwark 1998: 1).

3.2.6.1 The borough of immorality

The area south of the Thames quickly became overrun by breweries, brothels, playhouses and prisons due to being less socially stringent than the City

(Higham 1955: 244; Roberts and Godfrey 1950; Sheppard 1998: 196; Thorold 1999: 103). However, some of these bawdy-houses had been present in the area since the fourteenth century (Noorthouck 1773). From very early on, Southwark had a reputation for being the receptacle of all things immoral, including vices such as drinking, as well as the place where the rejected citizens, characterised as idle and dissolute, would live (Golden 1951: 22; Thorold 1999: 103; Walford 1878b). This reputation led an array of unsavoury individuals such as felons, outlaws, debtors and vagabonds to decide to settle in the area as London's officers of justice would not dare venture within this seedy borough (Walford 1878b). Within the borough of Southwark, the poorest residents of London were found in the parish of St Saviour's, where 68% of the 33,000 people within were classified as poor (Tames 2001: 128). As a result, the dwellings found within the borough represented such depravity and destitution (Walford 1878b) and the surrounding environment was extremely polluted and unsanitary (Reilly 2009; Reilly et al. 2001).

3.2.6.2 A 'single women' (prostitutes) and pauper burial ground

The Cross Bones burial ground is associated with the parish of St Saviour's and is located at the corner of Redcross Way and Union Street in Southwark (Bard 2008: 115-116; Brickley et al. 1999: 5). The parish church of St Saviour's is one of the largest parish churches in London (Reilly 2009: 35) and certainly serves one the poorest parishes in London (Higham 1955: 251; Tames 2001: 128). This burial ground was located far from the St Saviour's parish church (Figure 3.15) (Bard 2008: 115; Holmes 1896: 183-184), probably due to the nature of the individuals buried within. Cross Bones had been used as a single women's (i.e. prostitutes) cemetery due to the ground being unconsecrated and it later served both the men and women of the very poor population of the parish, the paupers (Bard 2008: 115; Brickley et al. 1999: 5-6; Holmes 1896: 183-184).

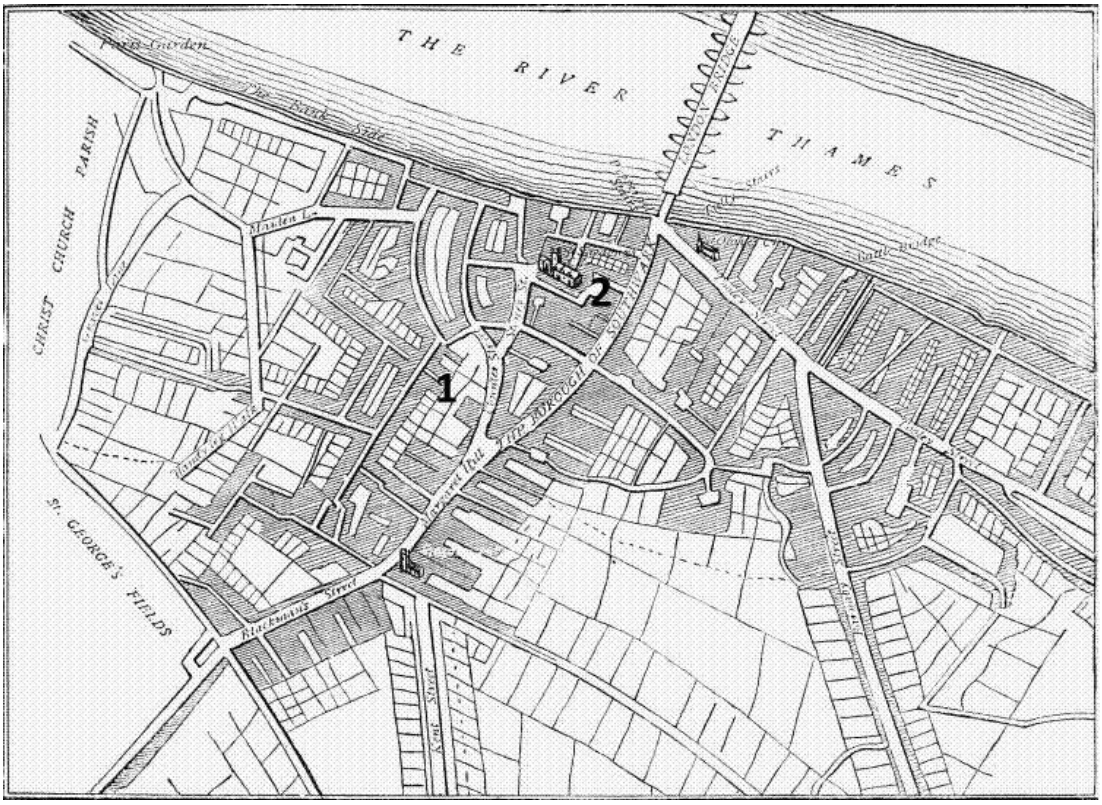


Figure 3.15 - Map of Southwark in 1720 (Walford 1878b) with the identified approximate location of (1) the Cross Bones burial ground and the approximate location of (2) the parish church of St Saviour's, also identified by the small drawing of a church.

The archaeological evidence is consistent as only 23.4% of the retrieved, and crudely constructed, coffins had any evidence of having been decorated (Brickley et al. 1999: 26). Furthermore, the standard wood customarily used to build the coffins was elm during post-medieval London (Bashford and Sibun 2007: 112; Cowie et al. 2008: 31; Miles et al. 2008: 59); yet, in this burial ground, the identifiable wood was found to be pine, spruce and larch which were much less expensive then elm (Brickley et al. 1999: 26). The burials were dated to be between 1800 and 1853 (Mikulski 2007). There had been a problem twenty years prior to the latter date where graves could only be buried at two feet from the surface due to lack of space. The burial ground was finally closed in 1853 due to being teeming with burials (Bard 2008: 117; Brickley et al. 1999: 17; Holmes 1896: 309). Part of the burial ground was exhumed due to the construction of a new electricity sub-station in concordance with Transport for London's Jubilee Line Extension Project (Brickley et al. 1999: 2)

3.2.6.3 Cross Bones [REW92]

The excavations for this site were undertaken during 1992-1993 and 142 individuals were exhumed (Mikulski 2007) and analysed by MoL CHB. The number of individuals exhumed is believed to represent less than 1% of the total number of individuals buried within this cemetery (Brickley et al. 1999: 29). As opposed to the other collections, the sample from Cross Bones has more juvenile skeletons than adult skeletons. As a result, 45 adult skeletons were analysed for this study, of which 21 are males, 22 are females and only two are of unknown sex (Figure 3.16). This collection is also the only one to present more female skeletons than males.

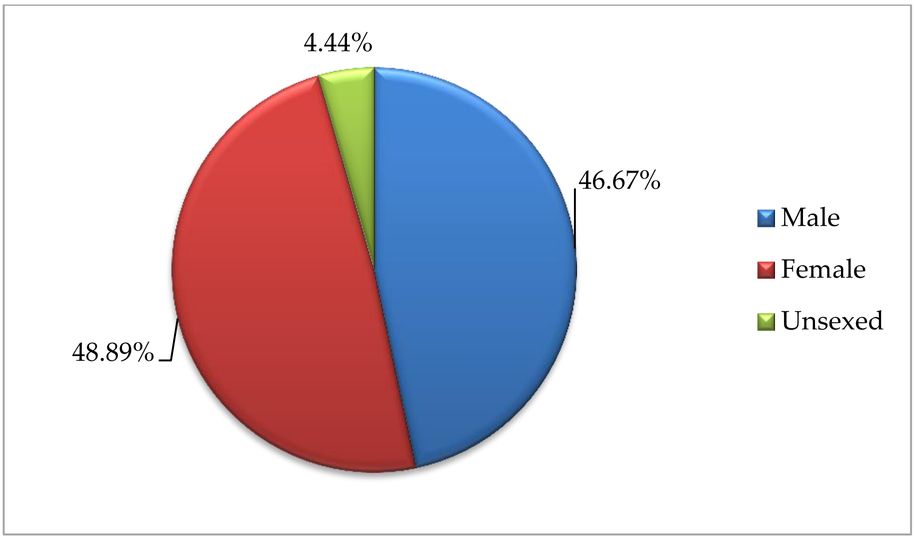


Figure 3.16 - Sex distribution for the individuals from Cross Bones.

In terms of age distribution, there are 11 YA, 17 MA, 14 OA and only one indeterminate adult (Figure 3.17). Finally, this collection only has 11 individuals who exhibit a fracture.

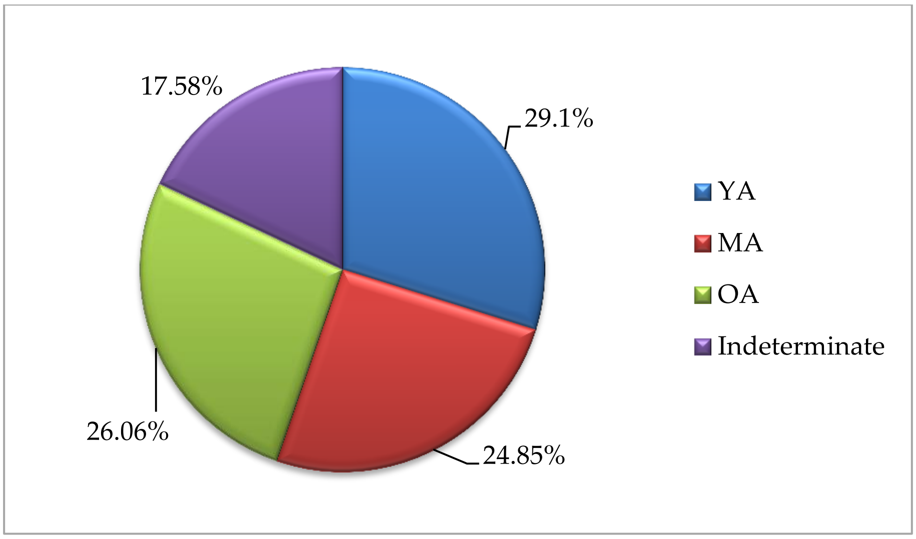


Figure 3.17 - Age distribution for the individuals from Cross Bones.

3.3 SUPPLEMENTARY MATERIALS

Described within this section of the chapter is additional information pertaining to the skeletal material. The difficulties encountered with juvenile skeletons and the collection from Bowling Green Lane, as well as the degree of preservation of each individual collection is presented. The database used during the laboratory phase as well as the information entered within is also described.

3.3.1 Encountered limitations

3.3.1.1 Juvenile skeletons

Firstly, it should be noted immediately that violence against children is an extremely complex and difficult area of study. Adding juvenile skeletons to the study will only further hinder the results because, unlike an adult skeleton, that of a child's is continuously growing until they reach maturity. As a result of these continuous changes in the juvenile skeleton, and when there are no intrinsic and extrinsic issues deterring the healing process, it can be possible for a fracture to heal in half the time it takes for a fracture seen on an adult's skeleton to achieve the same result (Ortner 2003: 128; Walker et al. 1997: 205).

Subsequently, fractures could be completely obliterated by the time a child reaches adulthood (Ortner 2003: 119). In contrast, when an adult suffers a fracture, that evidence is more likely to be apparent throughout most of their lifetime, which gives a record of one's injuries (Mays 1998: 176). Furthermore, fractures are less common in juvenile skeletons as the bones are much more flexible and less likely to break; this is especially true with younger children (Tomasto Cagigao 2009; Walker et al. 1997). Consequently, the project strives to consider the initial circumstance of violent interactions in recent times. This could in turn lay the groundwork for ensuing studies that focus on sub-adults.

3.3.1.2 Bowling Green Lane

The collection from Bowling Green Lane, curated at AOC in London, UK at the time of the laboratory analysis in the autumn of 2012, does present a few problems within this thesis; however, it was deemed important to use the data collected from this collection whenever possible. Out of the six skeletal collections utilised in this project, Bowling Green Lane only has data pertaining to the skeletons with a fracture and the skeletal inventory is incomplete. The skeletons exhibiting trauma from Bowling Green Lane were identified with the help of Dr Ives (pers com, 2010). Age, sex as well as ante-mortem fractures were recorded on the individuals identified as exhibiting fractures due to time constraints, with the hope of returning to gather the remaining information at a later date. The percentage of each individual skeleton that was present and the degree of preservation was also notated.

Unfortunately, the unavailability of the laboratory space and the skeletal material has made it impossible to return. This also means that there is very little information gathered regarding the individuals without a fracture. The total number of skeletons in the collection as well as the total number of adult males and females is published, while the age distribution of the collection is not. As a result, only crude prevalence rates can be determined with this particular collection. Regrettably, this will mean that the collection from Bowling Green Lane will be omitted from some of the statistical tests especially when observing and analysing the true prevalence rates, explained below in section 3.5.1.2. It will be indicated in the following three chapters presenting the results when this collection is omitted from certain sections.

3.3.2 Preservation

The degree of preservation of the skeletal material can very well affect the prospect of carrying out age and sex estimations, as it is quite possible that the bones used for such estimations are either missing from the skeletal inventory, or that they have been damaged to the degree where sexing and aging is not feasible. Furthermore, if the skeleton is not well preserved, it is very likely that it can obstruct or obliterate altogether signs of a healing or healed fracture. Preservation within a skeletal population must be taken into account as skeletons will not suffer from or react to the same taphonomical events as others, even when from the same burial ground (Henderson 1987).

Each skeleton was defined as being "< 25% present", "25%-75% present" or "> 75% present". These percentages took into account the bones that were present and how much postmortem damage appeared on the bones. Postmortem damage can present itself in a number of ways and with various degrees of damage. It can be caused by environmental factors such as: weathering, root stains, small carnivores and rodents. It can also be accidentally caused with tools and equipment used during excavation (Larsen 1997: 109). At times, there is a small area of the bone which is affected, where the cortical bone has eroded and trabecular bone is visible. Or, the postmortem damage can be so extensive that only a small portion of the entire bone remains. As a result, some of the skeletons had almost all their bones present but since the postmortem damage was extensive, they were classified in the group of "25%-75% present" rather than the group where more than 75% of the skeleton is present. When examining the degree of preservation for a whole collection (Table 3.1), it was deemed 'moderate' when there were more individuals categorised as having between 25% and 75% of their skeleton present. The preservation was established as 'good' for the collection when the majority of the individuals exhumed from the burial ground had more than 75% of their skeleton present. In the case of St Bride, there are more individuals with 25% to 75% of their skeleton present; yet, the preservation of the collection was deemed 'good' due to the much lower number of individuals with poor preservation.

Table 3.1 - Degree of preservation found within each collection.

Site	Total number of individuals	Degree of preservation	75% and up	25% to 75%	Lower than 25%
Chelsea	165	Moderate	39	73	53
Kingston	42	Moderate	9	26	7
BGL	135*	Good	59	55	21
St Benet	162	Moderate	34	86	42
St Bride	362	Good	128	171	63
Cross Bones	45	Good	23	19	3

*This figure only represents the number of individuals with a fracture.

The majority of the individuals were found to have between 25% and 75% of their skeleton present during the analysis. Furthermore, in all cases, the number of individuals with poor preservation was rather low compared to those of moderate or good preservation within the same collection. The collection with the highest percentage of individuals with more than 75% of their skeletons present was found in the collection from Cross Bones where 51.11% had good preservation. When looking at the number of individuals in each collection with less than 25% of their skeleton present, Chelsea had the highest percentage of individuals with 32.12%.

Unfortunately, it did at times occur that very few bones, or sometimes only one, were associated with a context number. Nevertheless, these context numbers are associated to an individual and must be included in the data and analysis of the collections. To leave out such individuals would further hinder the results. As a result, true prevalence rates, which are discussed below in section 3.5.1.2, are calculated in order to get results that are more accurate and representative and effectively take into account the degree of preservation seen on the skeletal material.

3.3.3 Database

All recorded information was inputted into a Microsoft Office 2010 Access database where all the skeletons from each collection could be viewed. The raw data can be viewed in Appendix 1. A principal table was created where the site code and context number were carefully entered for each skeleton as some context numbers repeat themselves when the various collections are grouped together. Additionally, the following information was recorded: age, sex, degree of preservation, bones present and visible trauma.

When creating the database in Microsoft Access, a system error was encountered when attempting to create the desired number of fields (i.e. columns) stating that too many fields had been defined in the table. In addition to the age, sex, degree of preservation and visible trauma fields, the desired fields included one for each of the cranial and maxillofacial bones, one for every bone in the post-cranial skeleton, as well as a field to describe the visible trauma according certain anatomical categories, such as skull trauma, rib trauma, upper limb trauma, etc. In order to counteract that error, certain bones were grouped together when notating them in the database creating a table with a lesser number of fields. As a result, the carpals, tarsals (with the exception of the calcaneus and talus, which each had their own field due to their substantial size compared to the other tarsals), metacarpals, metatarsals, as well as all hand and foot phalanges were grouped and entered in separate fields for each general classification. It was possible however, to include a field for the respective proximal, intermediate or distal phalanges for both the hands and feet. The bones were identified as left or right; and, an unknown option, identified as "?", was available for the hand and foot phalanges when siding those particular bones proved to be questionable. However, when one of the bones in the above general groupings showcased evidence of a healed fracture, it was properly identified as the specific carpal or metacarpal, for example, and notated as such in the second table of the database which collected information on the visible fractures (Appendix 2). Having information on which bones are present for each individual is valuable data, especially when calculating true prevalence rates. For example, if an ulna is missing from an individual's skeletal assemblage, there is no possible way to know with absolute certainty if that particular individual suffered a fracture on that bone or not. As a result, true prevalence rates are necessary as they take into account the number of bones present within the calculations rather than the number of individuals that are present.

The aforementioned second table of the database was established in order to have detailed information pertaining solely to the ante-mortem fractures seen on the individual skeletons. The two tables were linked via the individuals' respective site codes and context numbers so that they can be easily retrieved when needed. As a result, these tables can also be viewed separately or combined as one. When a bone presented an ante-mortem fractured, its exact location on the body was recorded. When multiple fractures were located on the same bone or type of bone (e.g. the ribs), any such occurrences were delineated with a letter of the alphabet in order to keep them separate (e.g. Rib A, Rib B, Rib C, etc.) Fractures located on the cranium were categorised as such in the second table when identifying the bone that displayed the fracture with more specific information regarding the exact affected bone of the cranium found in the description of the fracture.

3.4 METHODS

This section presents the methods utilised to determine the biological profile for each analysed skeleton as well as the presence of fractures on the bones. Furthermore, the fractures' subsequent anatomical groupings used in order to observe the dispersal of fractures on the body is also presented.

3.4.1 Age determination and sex estimation for the skeletal material

The process of aging and sexing a skeleton are always estimations, especially when aging the skeletal material, as the only way to be completely assured of their accuracy is to have access to records stating sex and age at death for the individual. Evidently, due to a number of circumstances, these records are not always available. Even though age estimations and sex determinations were carried out by the institutions which originally exhumed the remains, the biological profile was reassessed for every skeleton that was analysed in this current study. This was done as very few had known records. Furthermore, this process allowed the data to be collected in a standardised manner as the age categories used by the MoL CHB, AOC and BU to catalogue the skeletal material differ slightly from one another. As a result, the age was re-estimated in order to have all the observed skeletons matched with one of the three age categories utilised in this study (presented below in section 3.4.1.2). However, due to varying degrees of preservation, some individuals are unfortunately of unknown age and/or unknown sex.

3.4.1.1 Sex

The skeletons were sexed using methods that focused on the skull and the os coxae. For the skull, some of the distinguishing characteristics used to determine sex are: the nuchal crest, the mastoid process, the supra-orbital margin, the supra-orbital ridge or glabella, as well as the mental eminence and the gonial angle on the mandible (Acsádi and Nemeskéri 1970; Bass 2005; White and Folkens 2000). For most of these characteristics, sexual dimorphism is present especially when observing the robustness or the protuberance of the features. The more robust or the more the feature protrudes, the more likely it is to be a male individual rather than female. Furthermore, the female skeleton tends to be smaller in size and more gracile as well as lighter in construction. However, it is very important to notate all the sexing characteristics as it is very possible to have a skull which demonstrates some male features as well as some that are more identifiable as female (Bass 2005: 81; White and Folkens 2000: 362-363).

As for the os coxae, the ventral arc, the subpubic concavity, and the ischiopubic ramus ridge (Bass 2005; Phenice 1969; White and Folkens 2000); as well as the greater sciatic notch (Acsádi and Nemeskéri 1970; Bass 2005; Buikstra and Ubelaker 1994; Walker 2005; White and Folkens 2000) are characteristics used for distinguishing sex. In this case, the presence of a ventral arc, a subpubic concavity and a ischiopubic ramus ridge are indicative of female traits; when absent, the os coxae is more indicative of being male (Bass 2005: 208-210; Buikstra and Ubelaker 1994: 16-17; White and Folkens 2000: 367-369). As for the greater sciatic notch, the width of the characteristic is what will distinguish sex with the wider breath being indicative of a female trait (Bass 2005: 210; Buikstra and Ubelaker 1994: 18; White and Folkens 2000: 366). The wider features of the female pelvis are associated with allowing a baby's head to pass through the birth canal. Likewise, all available features were notated so that if there were characteristics presenting contrasting results, the sex was determined by the highest cumulative result. The os coxae presents a much more accurate sex determination than the skull due to its role in childbearing; however, at times, only the skull is available.

The skeletons were sexed as male, probable male, female, probable female or unsexed adults. In order to conduct the statistical analyses, the probable males and probable females were grouped within their respective sex so that there would not be too many categories. Lastly, there were no statistical analyses which were delineated by the individuals of unknown sex. However, it was possible to estimate the age for some of these individuals, and as a result, they were included in the statistical analysis when the collections were divided accordingly to focus on the age categories.

3.4.1.2 Age

As for aging the skeleton, methods were also dependent on the availability and the degree of preservation of the bones. Estimating an individual's age at death is always presented as a range rather than a specific number due to the variability seen in the features used for such estimations. The main methods used are: the epiphyseal fusion of the sternal end of the clavicle (Scheuer and Black 2000), the Suchey-Brooks method for the metamorphosis of the pubic symphysis (Brooks and Suchey 1990), and the metamorphosis of the auricular surface of the os coxae (Lovejoy et al. 1985; White and Folkens 2000). Aging an individual with the sternal end of the clavicle involves observing the degree of fusion found between the metaphysis and epiphysis and is useful for adults under the age of 30 (Scheuer and Black 2000: 251). The other methods, which observe the metamorphosis of a surface, tend to follow the notion that younger individuals have a billowy or rugged surface which presents horizontal ridges and superseding grooves, while the older individuals have a much more irregular surface created by erosion and general deterioration (White and Folkens 2000: 349-351). At times, the metamorphosis of the sternal rib end was also used sparingly (Bass 2005; İşcan et al. 1984, 1985).

Lovejoy et al.'s (1985) method to determine age-at-death using the auricular surface was used primarily due to prior training with this particular method. As the data collection phase of the research had begun with this method, its use continued in order to standardise the collection when other methods (Buckberry and Chamberlain 2002; Osborne et al. 2004) were brought to attention. Even though reviews of Lovejoy et al.'s (1985) method call into question the accuracy of the small age ranges and its possible difficulty of use, Mulhern and Jones (2005: 64-65) found that inaccuracy using Lovejoy et al.'s (1985) method was much lower for the young and middle adult age categories while Buckberry and Chamberlain's (2002) method was optimal for determining an age range for older individuals (i.e. over 50 years old) when comparing the accuracy of the two methods. As such, Lovejoy et al.'s (1985) method was maintained due to the large age ranges used in this study. The skeletons were aged into the following categories according to those found in Buikstra and Ubelaker (1994): young adult (20-34 years old), middle adult (35-49 years old), old adult (over 50 years old) and indeterminate adult.

Like the sex classifications above, there were no statistical analyses that focused specifically on the individuals of unknown age. However, it was possible to determine the sex of some of these individuals of unknown age; as such, they were included in the statistical analysis when the collections were divided according to each sex.

3.4.2 Analysing ante-mortem fractures

Due to the limitations described in section 2.2.4 of Chapter 2 regarding the difficulties with peri- and post-mortem fractures, ante-mortem fractures, where signs of healing were visible, were chosen for this study. Furthermore, as seen in section 2.3.5 of Chapter 2, interpersonal violence was an acceptable occurrence in London during the 18th and 19th centuries as long as rules and regulations were followed. Since fatally injuring one's opponent was punishable by law and homicide rates are not at the core of this study, ante-mortem fractures or survivable interpersonal violence is the focus.

3.4.2.1 Healed and healing fractures

The current study clusters the healed and healing fractures together as few individuals (n = 19) had fractures characterised as healing which accounts for 5.54% of the individuals exhibiting fractures (n = 343). Some of the results presented in Chapters 4 through 6 present statistical results with very low or non-existent affected numbers when observing the different collections, the sexes and age categories, as well as the anatomical location of the fractures. Low observed and expected numbers within statistical tests can cause a problem with the execution and legitimacy of the tests and their results (see section 3.5.2 found below) due to the small sample size. As such, the presence of healing fractures was not compared to the presence of healed fractures. However, the presence of healing and healed fractures is explored further in Chapter 7. In certain sections of that particular chapter, the size and description of the callus is presented in order to explore either the possibility of abuse or, the possibility that the healing fractures could perhaps unveil further information when exploring the fracture prevalence rates according to the age categories.

3.4.2.2 Notated characteristics of the fractures

Once a fracture was observed, the fracture line's directionality and location were recorded in order to determine its possible aetiology. The presence of calluses was notated as well as a description of its size, smoothness and visible signs of healing. Furthermore, in order to get an idea of which fracture happened first in the cases of individuals with multiple fractures, the description of the callus was very important. When fractures occur in the same area, such as the ribs, it may be possible to determine if some fractures were perhaps the result of multiple incidents as they tend to heal at a similar rate if they are not interrupted by further trauma or other circumstances (Ortner 2003). This means that multiple rib fractures that occurred at the same time will most likely have the same features when they are healing. As a result, if one callus is larger than the others it could be explained by injury recidivism. However, as mentioned in section 2.2.3 of Chapter 2, many different factors can affect the healing processes and speeds. Consequently, it can be very difficult to accurately put a chronological order on fractures that are located on various areas of the body. Furthermore, the healing rates can be hard to quantify (Powers 2005: 8-9). As a result, the aforementioned description of the callus can certainly assist with determining the fracture's healing or healed status; then again, it is not an infallible method.

3.4.3 Anatomical categorisation of the notated fractures

In section 2.2.6 of the previous chapter, five of types of fractures were identified as being more commonly associated with incidents of interpersonal violence: depressed cranial fractures, nasal fractures, ulnar fractures, rib fractures and metacarpal fractures. Statistical analyses were undertaken in order to compare the prevalence rates between each collection and each fracture type so that incidents of interpersonal violence could be revealed. However, in order to get a more accurate vision of the fracture patterns seen in 18^{th}- and 19^{th}-century

London, the anatomical distribution of the exhibited fractures must firstly be taken into account.

As a result, the fractures were assembled into six groups according to their location on the body. The six anatomical groups are as follows: the skull, the torso, the upper limbs, the hands, the lower limbs and the feet. In order to avoid confusion, a listing the bones included in each group is presented here. Any fracture which occurred on the cranium and the mandible were characterised as skull fractures. The torso assemblage had the most bones within its category: the sternum, clavicles, scapulae, ribs, vertebrae and sacrum. Subsequently, the humeri, ulnae and radii were characterised as bones from the upper limbs. Any carpal, metacarpal and hand phalanx were grouped under hands. Other than the obvious bones within the lower limbs category (i.e. the femurs, patellae, tibiae and fibulae), the os coxae were also included in this group. Lastly, the tarsals, metatarsals and all foot phalanges are found within the foot category.

In the analysis and statistical phase of the project, these categories were explored prior to analysing the presence of possible markers of interpersonal violence. This allows for a clearer depiction and understanding of the dispersion of the exhibited fractures according to the areas of the body prior to observing violence–related fractures. For example, most fractures found on the lower limbs and feet are more commonly associated with accidents than violence (Judd and Roberts 1999: 240; Rodriguez-Martin 2006: 207) and if a collection displays a rather large amount of lower limb fractures, it may indicate a lower prevalence of interpersonal violence and a higher rate of accidents within a certain group or collection. The comparison of fracture patterns is done by computing the prevalence rates and performing statistical tests which are presented below.

3.5 Statistical analysis

Comparisons between the collections need to be established in order to ascertain whether the literary accounts mirror the physical evidence found on the bones. The first step is to establish the prevalence rates of the individuals with a fracture. Once this has been accomplished, the rates are compared and tested in order to determine if the visible differences between the rates are statistically significant. The statistical tests were carried out using IBM SPSS Statistics version 19. Finally, in order to present the results in a manner that is more comprehensible, odds ratios and standardised rate ratios were also calculated and their method is also presented.

3.5.1 Prevalence rates

Prevalence rates are used in all sorts of studies in order to measure the percentage of a population who suffer a definite condition at any one time (Roberts and Cox 2003: 2-3; Waldron 1994: 42). Furthermore, the prevalence of fractures on skeletal material can give insight into the influence of different lifestyles by analysing the rates for various fracture types and the patterns they present regionally and chronologically (Larsen 1997: 110). In the current study, the proportion of individuals who have suffered a fracture during their lifetime is the objective, in order to compare those rates between various collections from post-medieval London. This proportion of the population is simply calculable; the number of individuals with the condition is divided by the total number of individuals in the population and then multiplied by 100 in order to get a percentage. That percentage is the desired fracture prevalence rate. The subsequent comparisons give insight into possible changes seen in patterns of the condition (Waldron 1994), which in this case relates to fractures. Finally, two different types of prevalence rates can be calculated: crude and true rates.

3.5.1.1 Crude rates

When the whole population is taken into account, the results are crude (Waldron 1994: 45). When simply looking at the proportion of individuals with a fracture, where the anatomical location of the fractures is briefly disregarded, within the collective sample and within each collection (Chapter 4), the crude fracture prevalence rates were calculated for each sample. When specific fractures or anatomical areas were observed, it was possible to calculate two crude prevalence rates: (1) the population's crude fracture prevalence rate and (2) the sample with fractures' crude prevalence rate. The population's crude rate is obtained when comparing each collection to the collective sample (n = 1268) regardless of the individual having suffered a fracture over the course of their lifetime. The crude rate stemming from the sample with fractures presents the percentage of individuals with a specific fracture when compared to the total number of individuals who have a fracture (n = 343). As a result, this secondary crude rate is calculated by measuring the proportion of either the number of individuals with a fracture in a particular anatomical area (Chapter 5), or the number of individuals with a possible marker of interpersonal violence (Chapter 6), taken from the total number of individuals who have suffered fracture, regardless of the its location on the body.

3.5.1.2 True rates

However, in order to get a more accurate representation of the uncovered patterns, true rates are calculated which is achieved by using the number of bones present, taken from the skeletal inventory entered in the database, instead of using the total number of individuals (Waldron 1991; 1994). For example, when looking at nasal fractures, the number of individuals exhibiting that particular fracture was divided by the number of individuals with the nasal bones present in their skeletal inventory, and then multiplied by 100 in order to calculate its true prevalence rate. As a result, any individual without nasal bones was omitted and it gives a clearer proportion of the number of individuals in the skeletal sample that are affected by this fracture type. When the types of fractures, such as the possible markers for interpersonal violence and the fractures in each anatomical category, were observed, both the crude and true prevalence rates were calculated.

The information gathered from Bowling Green Lane does presents a problem when calculating the true fracture prevalence rates due to its incomplete skeletal inventory. As a result, the individuals from Bowling Green Lane were omitted when such calculations were performed. However, those individuals were included when calculating the crude rates, especially when observing the collective sample and the number of individuals with a fracture regardless of their location or type. It will be stated in the text of the following three chapters when this occurs.

3.5.2 Statistical tests

The data collected for this study is categorical and as a result, the individuals can only fall into one category (Field 2009: 687). In this case, they have either suffered a fracture over the course of their lifetime, or they have not; they cannot be a part of both categories. When analysing such data, discovering frequencies is the intended outcome (Field 2009: 687). As a result, the statistical tests that can be computed with this type of data are limited to the chi-squared test and log linear analyses.

3.5.2.1 Chi-squared test

As a result of the data being categorical in nature, the Pearson's chi-squared test was used in order to compare the data. Chi-squared tests are used when the relationship between two categorical variables is explored (Field 2009: 687), such as, the correlation between the number of males with a fracture and the number without a fracture, within the collective sample or within a certain collection, for example. To ensure the significance of this statistical test, it is essential that each variable entered in the test corresponds to only one cell of the contingency table (Field 2009: 691). The contingency table for this test is usually 2x2 (i.e. evaluating the relationship between two variables each with two options); however, a larger contingency table can be and will be used over the course of this thesis. The number of comparisons that can be carried out can be endless and tailored specifically to finding out different answers.

The log linear analysis can also be used to compare categorical data and it looks to compare the relationship between more than two variables. However, this type of analysis is much more reliable when the expected frequencies, calculated within the statistical test, are large. The chi-squared test is a much more statistically powerful option when the sample is small (Field 2009: 710). Inevitably, small sample sizes were seen when categorising the fractures according to the anatomical areas and the possible markers of interpersonal violence; as such, chi-squared tests are used throughout the current thesis.

3.5.2.2 Presenting statistical test results

When observing the chi-squared results, the test statistic (χ^2), the degrees of freedom (df) as well as the *p*-value are reported. In order to determine if the relationship between two variables is or is not statistically significant, the *p*-value must be ascertained. In this study, when the *p*-value was equal or lower than 0.05, the results were statistically significant. This implies that there is a 95% probability that the differences seen between the variables were not due to chance.

3.5.2.3 Type I error

Statistics aim to determine whether or not there is an effect on the population under study (Field 2009: 55-56) and by conducting numerous chi-squared tests on data that has already been tested, the Type I error is inflated. The Type I error leads the researcher to believe that the effect detected on the population is genuine, when in fact, it is not (Field 2009: 56). It is very important to the value and power of the conducted statistical tests to be cognisant of the fact that the critical statistical value of 0.05 is subject to change when further tests are conducted on the same data. In the next three chapters, the chi-squared test found in each sex and age category is firstly applied to all the collections and applicable individuals of the sample. This was done so that the statistical significance that may or may not appear when searching for the relationship between the collections would be evident without conducting a large amount of statistical tests on the same data.

Consequently, the chi-squared test found in each of the respective sex or age category of the next three chapters includes all the relevant data for that category. This also includes the data from the opposite sex, for example, in order to keep the number of statistical tests performed on the data to a minimum. When both sexes were included in one chi-squared test, it was layered accordingly in order to obtain results pertaining solely to the males and females, as well as comparing both sexes. If the results were found to be statistically significant, *post hoc* tests are performed with a corrected critical statistical value.

3.5.2.4 The Bonferroni correction

If the difference between the number of males with and without a fracture was significant for the collective sample, it would be interesting to find out which of the six collections involved are contributing to that outcome. In order to do so, *post hoc* tests are performed or simply put, the data is compared in pairs (Field 2009: 372). However, as previously mentioned, this additional testing will inflate the cumulative Type I error over 0.05 if it is not corrected. In order to do so, the Bonferroni correction is applied (Field 2009: 372-375); as a result, the original critical statistical value of 0.05 will be divided according to the number of additional tests that are computed. These new tests will be significant if their *p*-value is lower than the newly corrected critical statistical value. At times, it was not necessary to conduct any *post hoc* tests since the collective sample, as well as the individual collections, were all included in one statistical test. Nonetheless, it will be indicated when the Bonferroni correction is applied in the following three chapters and, when applicable, the new critical statistical value will be presented.

3.5.2.5 Smaller sample size correction

As with most statistical tests, it is much more advantageous to have a large sample in order to retrieve the most accurate results. When the sample is smaller, the chi-squared results, which are in fact an approximation of a distribution, will be inaccurate. When the expected count of individuals is found to be lower than five, the results become erroneous and results from a different test must be presented. When this is the case, the results from the Fisher's exact test are given. This test is performed in the same way as the chi-squared test but this method allows the exact probability of the chi-squared statistic to be calculated (Field 2009: 690). When this correction is necessary, it will be stated in the text.

Nonetheless, there are some instances where the Fisher's exact test cannot be used. Unfortunately, the Fisher's exact test is only conducted on a 2x2 contingency table, where the degree of freedom is equal to one. As a result, the Fisher's exact test cannot be utilised when the contingency table is larger than

2x2 and this will be seen throughout the three chapters covering the results. However, entering the data into a larger contingency table does provide an alternative solution when having expected counts that are lower than five. When the table has a degree of freedom that is larger than one, it is permissible to present the chi-squared results as long as they have a minimum expected count of one and there is a maximum of 20% of the expected counts that have a value that is lower than five. When there is either more than 20% of the expected count that are lower than five or the minimum count is lower than one, the results are not acceptable (Field 2009: 692). This will be indicated in the text when it occurs.

3.5.3 Odds ratios and standardised rate ratios

Another way to compare the collections, that may be easier to read and understand than statistical tests results (i.e. *p*-values), is to compute the odds ratios. By doing so, it is possible to determine if one collection is more likely to have individuals who suffered a fracture than another and how many times more likely.

3.5.3.1 Odds ratios

Field (2009: 699-700) indicates that odds ratios are of use when one wants to measure the categorical data's effect size. In other words, it is a useful calculation when comparing collections in order to determine which has higher odds of presenting an individual with a fracture. In order to demonstrate the calculation of such ratios, they will be calculated and compared for the number of individuals with a fracture from the Chelsea and Kingston collections as an example. First, the number of affected individuals is divided by the number of individuals without a fracture for each collection. Subsequently, Chelsea's calculations would be 37/128 = 0.29; while the equation for Kingston would be 10/32 = 0.31. It is now evident that the ratio between Chelsea and Kingston is

0.29 : 0.31 which becomes 1 : 1.07. As a result, the individuals from Kingston are 1.07 times more likely to have suffered a fracture over the course of their lifetime compared to those from Chelsea. This calculation will be repeated for all comparisons between the collections, and will be presented in the following three chapters, in addition to the *p*-values, as it is much simpler to comprehend.

3.5.3.2 Standardised rate ratios

However, the method described above does not include any method for standardising the results. Waldron (1994: 61-62) states that the age and sex structures of the population will have an effect on the numbers used to calculate the ratios. Furthermore, it is not possible to compare standardized rates when different standards were used (Waldron 1994: 66). Consequently, this method was not utilised when the collective sample is observed as the data is standardised according to age or sex, not both at once. As a result, this would yield two sets of ratios, one standardised using sex and the other, age. The two sets may very well yield different results which would in turn be confusing. Unfortunately, since the age categories of the individuals without a fracture from Bowling Green Lane is not known, the collection is omitted from all of the standardised rate ratio calculations. This will be stated in the Results chapters when it occurs.

When the collective sample is further divided according to age and sex, the results will be standardised using the indirect method. Indirect standardisation applies the sex- or age-specific rates gathered from a population to the one under study to produce an expected number of cases. The expected number of cases is then summed for each sex or age group and compared to the observed number of cases, which will in turn produce a standardised rate ratio (Waldron 1994: 67). In order to clearly demonstrate the calculation of the standardised rate ratios, the comparison between the males and females in the collective sample, excluding those from Bowling Green Lane, will be used as an example. The standardised rate ratio is calculated by firstly allocating each sex a standard fracture ratio (SFR). The SFR takes the observed frequency, divides it by the expected frequency and then it is multiplied by 100 (Waldron 1994: 67). The observed frequencies are simply the number of individuals with a fracture in each sex, and subsequently divided according to each age category. In order to calculate the expected frequencies, the prevalence rate for each age category divided according to each sex must be calculated first. The prevalence rates of each age category for the males and females are presented in Table 3.2. For example, there are 101 YA males and 23 of those individuals have a fracture, so the prevalence rate for the YA males is 22.77%. The prevalence rates for the other age categories are calculated in the same manner.

Table 3.2 - Total number of individuals and number of affected individuals for each sex, as well as their respective prevalence rates, according to each age category.

Age category	Males			Females		
	Total number	Number affected	Prevalence rate	Total number	Number affected	Prevalence rate
YA	101	23	22.77%	91	8	8.79%
MA	149	47	31.54%	73	19	26.03%
OA	102	51	50%	63	56	88.88%

While Table 3.2 does give the prevalence rates for every age category in each of the sexes, the expected numbers must still be calculated for each of the age categories. As a result, the mean of the prevalence rates for each age category seen in Table 3.2 are calculated in order to obtain their associated prevalence rates seen in Table 3.3. The new prevalence rates are used to calculate the expected number for each age category. For example, the rate for the YA males is 22.77% and the YA females' is 8.79% (Table 3.2). In order to get the mean, the rates are added and then divided by two, as there are two values. As such, the combined prevalence rate for the YA is 15.78% (Table 3.3). A new prevalence rate is calculated for each age category. These new prevalence rates (Table 3.3) are then applied to the total number of individuals found in Table 3.2 in order to obtain the expected number of individuals for each age category in each sex. For example, there are 101 total YA males (Table 3.2) so the expected number of YA males is 15.78% of 101, which equals 15.94.

Table 3.3 - The observed and expected number of individuals for each sex divided according to the age categories and the mean prevalence rate of each age category.

Age category	Prevalence rate	Males		Females	
		Observed	Expected	Observed	Expected
YA	15.78%	23	15.94	8	14.36
MA	28.79%	47	42.9	19	21.02
OA	69.44%	51	70.82	26	43.75
TOTAL		121	129.66	53	79.13

Now that the observed and expected numbers are known, the SFR can be calculated for each sex. Based on Table 3.3, the SFR for the male population is equal to 93.32 and the SFR is 66.98 for the females when the observed counts are divided by the expected counts and then multiplied by 100. With these standard fracture ratios, the standardised rate ratio can be determined and is found to be 93.32 : 66.98. As a result, it is now ascertained that the males are 1.39 times more likely to have suffered a fracture than the females in the collective sample. The standardized rate ratios will appear numerous times in the following three chapters and it is important to understand the method behind their calculation.

Summary

In this chapter, the aims and objectives of the research were presented. Stemming from these declarations, research questions were revealed and hypotheses were formulated. Next, analysis of skeletal remains from that time and place must be carried out in order to collect the relevant data. Once the skeletal collections from post-medieval London were identified, a skeletal inventory was taken of each context number (i.e. individual) as well as a description of their degree of preservation. Furthermore, sex and age at death were estimated for each individual analysed. Once this information was collected, any ante-mortem fractures that were present were catalogued. With this information, various statistical analyses were the next step which will unveil any fracture patterns that can be found between the collections, sexes and age categories as well as any statistical significance that is found between two variables. Lastly, odds ratios and standardised rate ratios were presented which give a more concise representation of which population is more likely to suffer a certain type of fracture over another.

The following three chapters involve looking into the data and elucidating the results. The analysis will focus on the comparison of the prevalence rates of individuals with a fracture, regardless of its location or type (Chapter 4), as well as the rate of individuals with fractures in a specific anatomical area (Chapter 5) or a specific fracture type (Chapter 6). Those rates will be divvied according to collection, sex and age so that the hypotheses stated above can be either confirmed or refuted. As aforementioned, the collection from Bowling Green Lane does cause some problems due to the information on the collection being incomplete. However, the data from the skeletal assemblage was utilised whenever possible and is clearly indicated when it is not within the Results chapters. The first of the following three Results chapters examines the presence of fractures in the collective sample regardless of their anatomical location or possible relation to incidents of interpersonal violence.

Chapter 4
Results – Collective sample

The results were viewed from three different perspectives, and are subsequently presented in three separate chapters: (1) the overall amount of trauma observed within the collective sample with no specifications regarding the location of the fractures, (2) the amount of trauma when the fractures are divided into anatomical areas of the body (the bones included in each anatomical area are specified in section 3.4.3 of Chapter 3); and lastly, (3) the amount of observed trauma when focusing on fractures more commonly associated with incidents of interpersonal violence (the fractures that are possible markers for incidents of interpersonal violence are discussed in section 2.2.6 of Chapter 2).

Within each chapter the results are divided and presented according to groups. First, the collective sample regardless of the age or sex of the individuals is analysed and this is followed by a sub-section for each sex as well as each age category. Furthermore, there are two more sub-sections that compare the differences seen between the sexes and the differences between the age categories. The results found in each of these groupings are presented according to the number of individuals found in each collection. Lastly, each sub-section presents the relevant fracture prevalence rates, the results from the chi-squared tests and finally the odds ratios or standardised rate ratios for each specific group. Since a large amount of data is presented in the three results chapters, and in order to reduce the extent of confusion that may arise accordingly, the methods were presented in a concise manner that is repeated across each sub-section in this chapter as well as in the ensuing two chapters.

The current chapter focuses on all the individuals of the collective research sample regardless of the location of fractures. The aim of this section is to simply observe and determine the number of individuals with a fracture within the collective sample, as well as within each individual collection and according to each sex and age category. Since the section does not yet focus on the anatomical location of the fractures, all the prevalence rates presented below are crude rates. The next two chapters will focus on the fractures' anatomical location on the skeletons and then, on any possible markers of interpersonal violence. Consequently, the crude and true rates will be presented in those chapters. However, before those narrower points of view can be explored, the present chapter provides a general introduction to the fracture patterns seen in each sex and age category and in each of the collections that were analysed.

4.1. COLLECTIVE SAMPLE

Firstly, the percentages regarding the age and sex distributions for each of the collections seen in section 3.2 of Chapter 3 are configured together and presented here in order to illustrate the demographics of each collection. The sex distribution is found in Figure 4.1 while the one for age is found in Figure 4.2. However, Figure 4.2 does not present the age distribution for Bowling Green Lane (BGL) due to only being able to calculate the percentages found within the population exhibiting a fracture.

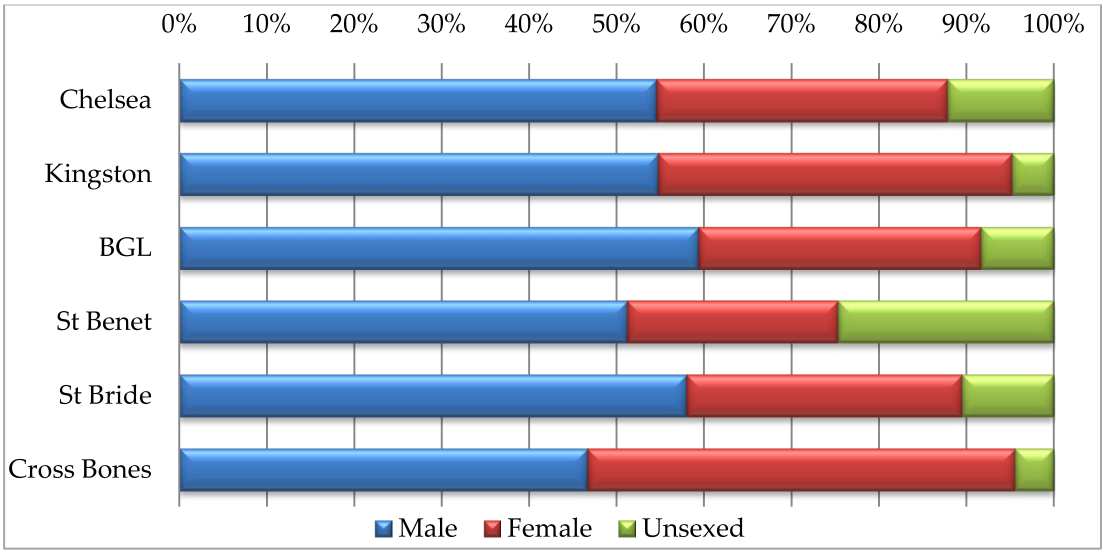


Figure 4.1 - Sex distribution for the individuals from every skeletal collection.

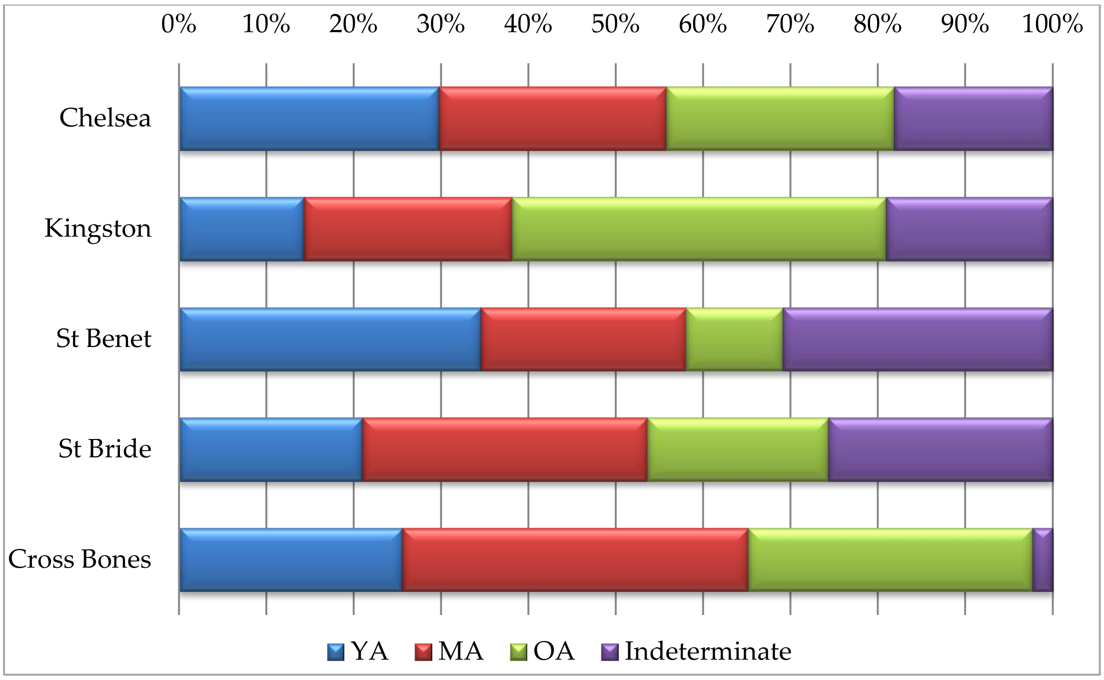


Figure 4.2 - Age distribution for the individuals from each skeletal collection with the exception of Bowling Green Lane.

4.1.1 Prevalence rates

Table 4.1 displays the total number of individuals for each collection as well as the number of individuals with a fracture regardless of the individuals' age or sex. Bowling Green Lane has the highest number of individuals with a fracture (n = 135) while the lowest number (n = 10) is found in the collection from Kingston.

Table 4.1 - The total number of individuals, as well as the number of individuals with a fracture (N.F), for each collection.

Burial ground	Total number of individuals	N.F
Chelsea	165	37
Kingston	42	10
BGL	492*	135
St Benet	162	17
St Bride	362	133
Cross Bones	45	11
Total	1268	343

*The total number of individuals for Bowling Green Lane provided by AOC.

St Benet has the lowest crude fracture prevalence rate of individuals with a fracture (10.5%) within its collection while St Bride has the highest with 36.74% (Figure 4.3). The rates from the other collections are much closer to the crude prevalence rate that is found among the collective sample, which indicates that 27.05% of individuals have suffered a fracture over the course of their lifetime. The rate for Bowling Green Lane is the closest to that percentage with 27.44% of its population exhibiting a fracture.

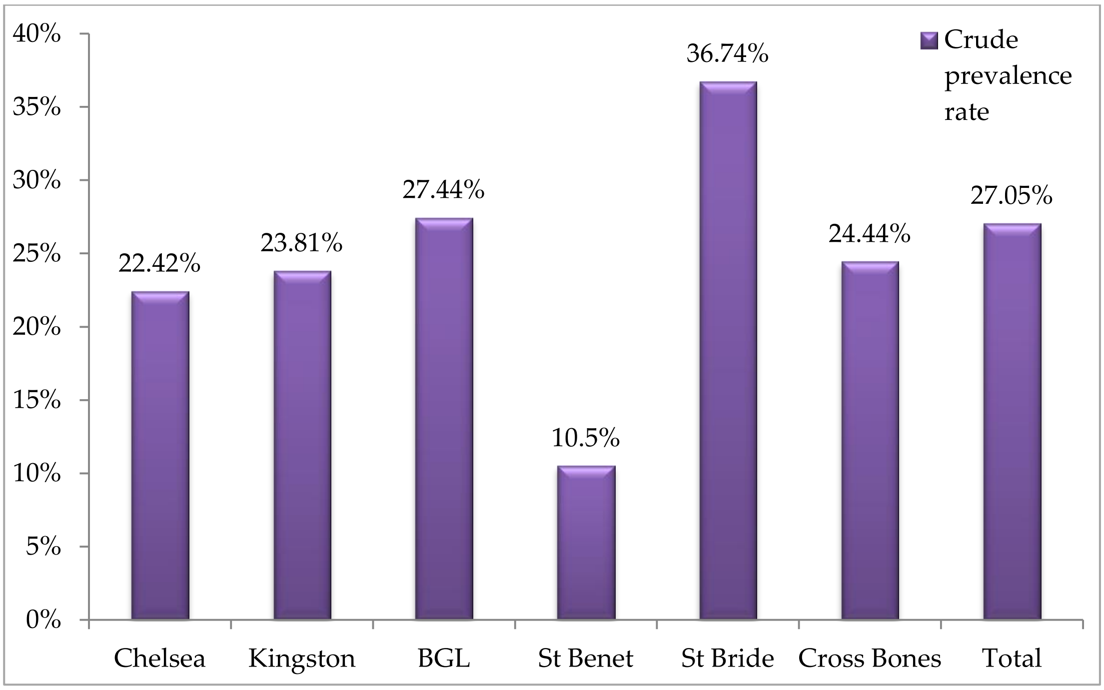


Figure 4.3 - The crude prevalence rates for the individuals with a fracture for each collection and for the total number of individuals.

4.1.2 Chi-squared test results

A chi-squared test was performed which included the number of individuals with and without a fracture, gathered from Table 4.1, for each of the collections. All six collections were entered in the same test and the results indicated that the relationship between the collections' differing prevalence rates were statistically significant ($\chi^2 = 41.934$, df = 5, $p < 0.001$). Refer to Chapter 3 for information on the statistical tests (section 3.5.2), possible encounters with Type I errors (section

3.5.2.3) and subsequent corrections (sections 3.5.2.4 and 3.5.2.5), used throughout the current and following two chapters.

Since the above test result was statistically significant, it is possible to find out which collections contribute to that outcome by performing *post hoc* tests (i.e. pair-wise comparisons). However, in order to prevent the inflation of the Type I error rate so that it does not equal a critical statistical value that is more than 0.05, the Bonferroni correction is applied (see section 3.5.2.4 of Chapter 3). These additional tests will demonstrate which collections contribute to the significant result ($p < 0.001$) seen above. In this case, rather than cross-comparing all the collections with one another, which would reduce the critical statistical value to a very restrictive amount, the comparisons (Table 4.2) will feature the collections with the highest and lowest prevalence rates seen in Figure 4.3. This makes for nine pair-wise comparisons which will correct the new critical value for statistical significance to $p = 0.006$ for the comparisons seen in Table 4.2.

Table 4.2 - Chi-squared values and *p*-values for pair-wise comparisons of each collection with St Benet and St Bride.

Comparison		χ^2 value	*p*-value
St Benet	Chelsea	8.439	**0.004**
St Benet	Kingston	5.150	0.038
St Benet	BGL	19.616	**< 0.001**
St Benet	St Bride	37.734	**< 0.001**
St Benet	Cross Bones	5.860	0.025
St Bride	Chelsea	10.630	**0.001**
St Bride	Kingston	2.752	0.124
St Bride	BGL	8.379	**0.005**
St Bride	Cross Bones	2.647	0.136

The results presented in **bold** show the *p*-values that are statistically significant. The degree of freedom for each comparison is 1.

The results that included the individuals from St Benet were statistically significant when compared to Chelsea ($p = 0.004$), Bowling Green Lane ($p <$

0.001) and St Bride ($p < 0.001$). As a result, the lower crude prevalence rate seen in St Benet (Figure 4.3) is inconsistent with chance variation when compared with these three collections. Furthermore, the results for St Bride are also statistically significant when compared to the individuals from Chelsea (p = 0.001) and Bowling Green Lane (p = 0.005). All other comparisons were not statistically significant.

4.1.3 Odds ratios

Calculating the odds ratios is a method that is more easily understood when expressing the results of the statistical tests, as opposed to what is presented above, as it determines which collection is more likely to have individuals who exhibit a fracture. Following the method description given in section 3.5.3.1 of Chapter 3, the ratios are presented below in Table 4.3.

Table 4.3 - Odds ratios for pair-wise comparisons between each of the collections.

	Odds Ratios	**Compared with:**
Chelsea	1 : 1.07	Kingston
Chelsea	1 : 1.32	BGL
Chelsea	2.42 : 1	St Benet
Chelsea	1 : 2	St Bride
Chelsea	1.1 : 1	Cross Bones
Kingston	1 : 1.23	BGL
Kingston	2.58 : 1	St Benet
Kingston	1 : 1.87	St Bride
Kingston	1 : 1.03	Cross Bones
BGL	3.17 : 1	St Benet
BGL	1 : 1.52	St Bride
BGL	1.19 : 1	Cross Bones
St Benet	1 : 4.83	St Bride
St Benet	1 : 2.67	Cross Bones
St Bride	1.81 : 1	Cross Bones

The highest odds ratio is found in the comparison between St Benet and St Bride where the individuals from the latter are 4.83 times more likely to have suffered a fracture than the former. The ratio between Kingston and Cross Bones, where the individuals from Cross Bones are only 1.03 times more likely to have suffered a fracture, is the lowest.

The collection from St Benet yielded statistically significant results when the number of individuals with a fracture was compared separately with the other collections. This is reflected in Table 4.3 as St Benet is always less likely than any other collection to have individuals with a fracture. Furthermore, the difference in the number of individuals with a fracture from St Bride was statistically significant when compared to those from Chelsea and the ratio states that they are in fact twice as likely to have a fracture as those from Chelsea. The results were also significant when St Bride was compared to Bowling Green Lane and they are 1.52 times more likely to have suffered a fracture over the course of their lifetime when they are from St Bride rather than Bowling Green Lane.

4.2 MALES

The above calculations were repeated for every sex and age category, beginning with the males in the skeletal sample.

4.2.1 Prevalence rates

Table 4.4 exhibits the total number of males, as well as the number of males with a fracture, in each collection. Similarly to what was seen in section 4.1.1, BGL has the highest number of males with a fracture (n = 99) while Kingston has the lowest number of males with a fracture (n = 5).

Table 4.4 - The total number of males, as well as the number of males with a fracture (N.F), for each collection.

Burial ground	Total number of males	N.F
Chelsea	90	26
Kingston	23	5
BGL	292	99
St Benet	83	13
St Bride	210	91
Cross Bones	21	7
Total	718	241

As seen in Figure 4.4, only the males from Cross Bones (33.33%) and BGL (33.9%) show a crude fracture prevalence rate that is similar to that of the collective male sample (33.43%). Similarly to the rates seen in section 4.1.1, St Benet has the lowest rate with 15.7% of the male population having suffered a fracture, while St Bride has the highest rate with 43.33%.

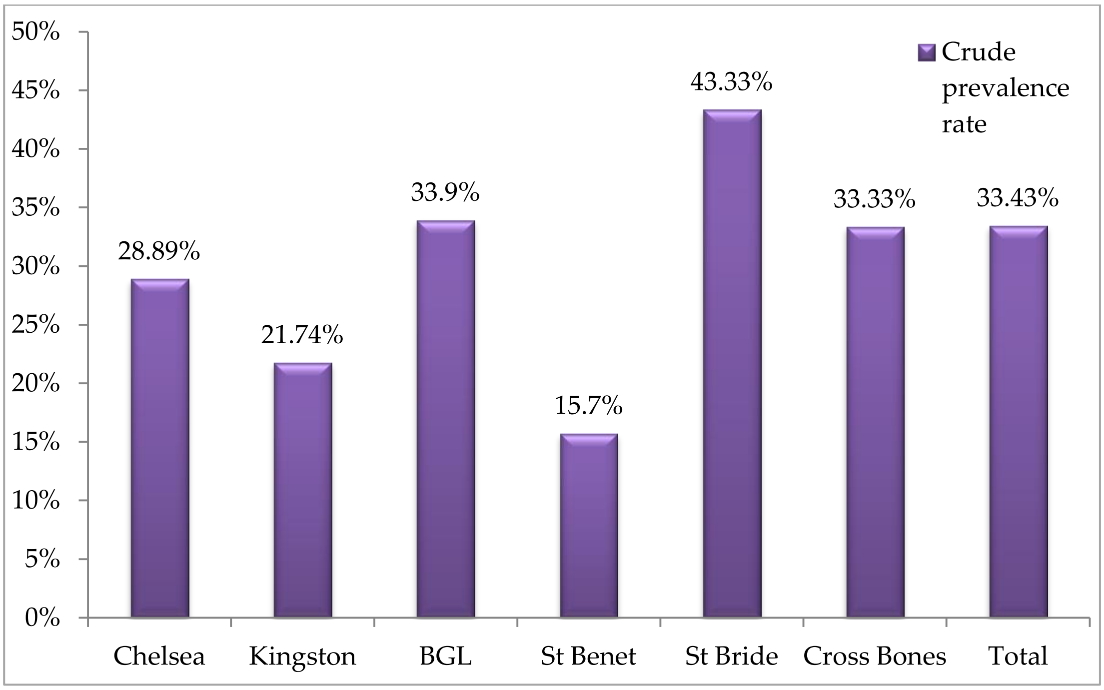


Figure 4.4 - The crude prevalence rates for the males with a fracture for each collection and for the total number of males.

4.2.2 Chi-squared test results

As in section 4.1.2, a chi-squared test was performed which included the total number of males with and without a fracture from each collection, gathered from Table 4.4. The data from all six collections were entered into one chi-squared test (Appendix 3, section 3.1.1). Similarly to the results of the collective sample in section 4.1.2, the results of the chi-squared test indicated that the differences seen between the collections' prevalence rates, when observing the male sample, were statistically significant ($\chi^2 = 23.271$, df = 5, $p < 0.001$).

In order to gain a better understanding of the significant result, the collections were once again cross-compared, in *post hoc* tests, to St Bride and St Benet separately (Table 4.5), as they represent the highest and lowest crude prevalence rate, respectively, seen in Figure 4.4. Nine additional tests were conducted and according to the Bonferroni correction, the new statistical critical value is $p = 0.006$ for the following comparisons.

Table 4.5 - Chi-squared and *p*-values for pair-wise comparisons between the males in each of the collections.

Comparison		χ^2 value	*p*-value
St Benet	Chelsea	4.326	0.045
St Benet	Kingston	0.472	0.534
St Benet	BGL	**10.267**	**0.002**
St Benet	St Bride	**19.893**	**< 0.001**
St Benet	Cross Bones	3.369	0.117
St Bride	Chelsea	5.525	0.02
St Bride	Kingston	3.99	0.072
St Bride	BGL	4.617	0.033
St Bride	Cross Bones	0.782	0.489

The results presented in **bold** show the *p*-values that are statistically significant. The degree of freedom for each comparison is 1.

There are only two comparisons that yielded significant results. The collection from St Benet produces significant results when compared with Bowling Green Lane ($p = 0.002$) and St Bride ($p < 0.001$). As a result, chance variation is not responsible for the rates of males with a fracture in these collections.

4.2.3 Standardised rate ratios

The rates were divided according to the individual collections in order to see if some collections are more likely to have males with a fracture than others. Since the collective sample has now been categorised according to age, standardised rate ratios are used rather than odds ratios and will be used throughout the rest of this chapter. Based on the method presented in section 3.5.3.2 of Chapter 3, the males from each collection were standardised using age. As a result, the collection from Bowling Green Lane is excluded and will be so in all the ensuing sub-sections of this chapter presenting standardised rate ratios. The observed and expected numbers of males with a fracture were calculated in order to obtain the standard fracture ratio for each collection, which subsequently is cross-compared in order to retrieve the standardised rate ratios found in Figure 4.5. A table presenting the ratios for each pair-wise comparison can be found in section 3.1.3.1 of Appendix 3.

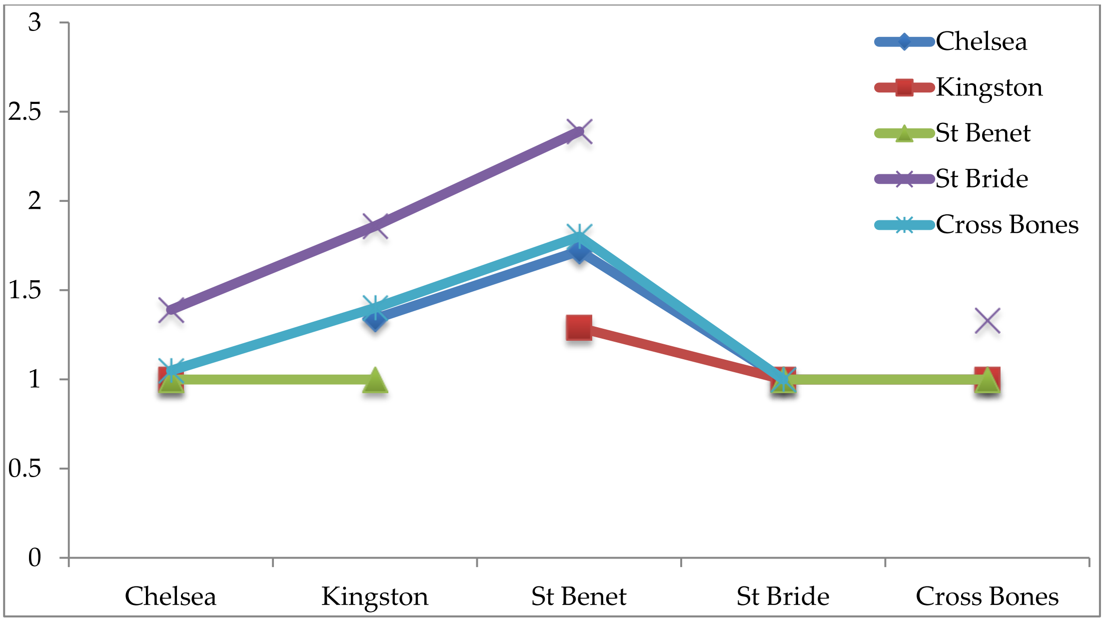


Figure 4.5 - Standardised rate ratios (SRR) for pair-wise comparisons between the males of each collection, standardised using age.

The highest rate ratio is found in the comparison between St Benet and St Bride were the individuals from the latter are 2.39 times more likely to have suffered a fracture than the former. This is the only instance where a collection is more than twice as likely to have a male with a fracture as any other collection. Furthermore, the ratio between St Benet and St Bride corresponds to a pair-wise comparison that is statistically significant (Table 4.5). On the other hand, the lowest ratio indicates that the males from Cross Bones are only 1.05 times more likely than those from Chelsea to have suffered a fracture.

4.3 FEMALES

4.3.1 Prevalence rates

Table 4.6 exhibits the total number of females, as well as the number of females with a fracture, in each collection. The females present a different outcome than the collective sample and the male sample. The collection with the highest number of females with a fracture is not found within Bowling Green Lane, but within St Bride (n = 35); although, the females from Bowling Green Lane are not far behind (n = 32). Furthermore, the lowest number of females with a fracture is not from Kingston; in this case, the lowest number (n = 3) is found in the collection from St Benet as well as the collection from Cross Bones.

Table 4.6 - The total number of females, as well as the number of females with a fracture (N.F), for each collection.

Burial ground	Total number of females	N.F
Chelsea	55	11
Kingston	17	4
BGL	159	32
St Benet	39	3
St Bride	114	35
Cross Bones	22	3
Total	405	88

The females (Figure 4.6) follow the same crude fracture prevalence rate pattern as the males (Figure 4.4), where St Benet has the lowest prevalence rate (7.7%) and St Bride has the highest with 30.7%. However, in this case, Cross Bones (13.64%) is not close to the collective female sample's rate of 21.73%, unlike in the male population. The remaining three collections, Chelsea (20%), Kingston (23.53%) and Bowling Green Lane (20.13%), have prevalence rates that are close to the rate of the collective female sample.

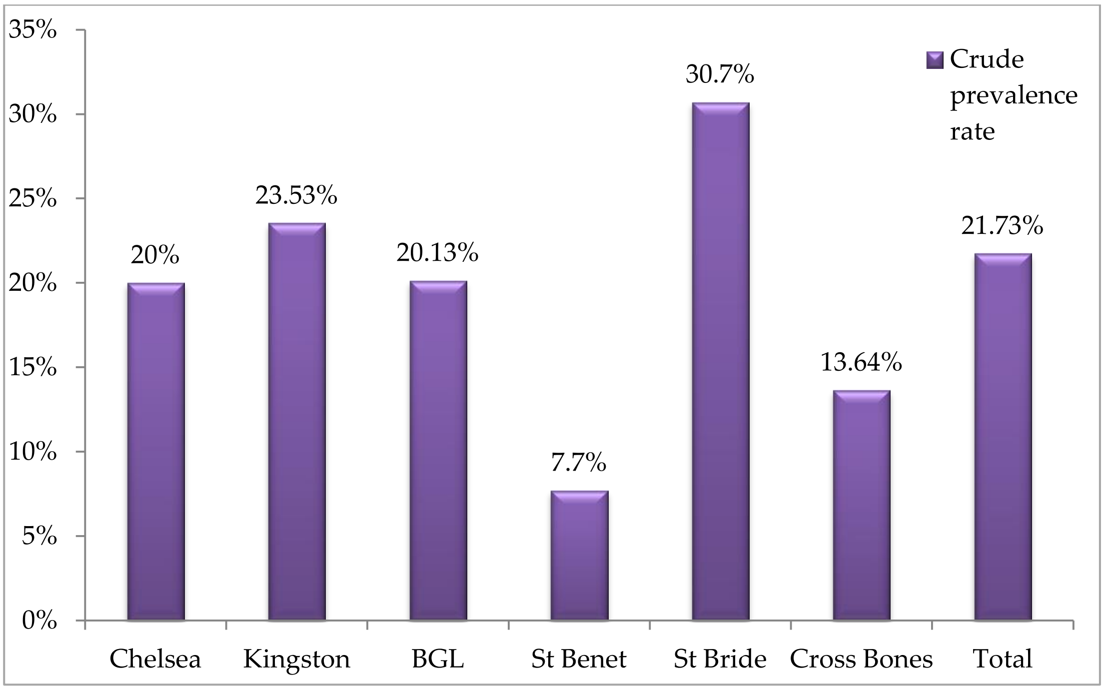


Figure 4.6 - The crude prevalence rates for the females with a fracture for each collection and for the total number of females.

4.3.2 Chi-squared and Fisher's exact test results

In the chi-squared test result for the female sample, there are some expected counts that are lower than five and the Fisher's exact test is not applicable in this case due to the degree of freedom being higher than one (i.e. the contingency table is larger than 2x2). However, the results are permissible due to less than 20% of the expected counts being lower than a value of five and the minimum count being more than a value of one (Appendix 3, section 3.1.1). As a result, it was found that the differences seen between the crude fracture prevalence rates of each collection were statistically significant (χ^2 = 11.151, df = 5, p = 0.001).

Similarly to what was done in the two previous sub-sections, the collections will be cross-compared in *post hoc* tests with St Bride and St Benet separately (Table 4.7). Once again, these two collections represent the highest and lowest prevalence rate, respectively, seen in Figure 4.6. There will be nine additional tests and according to the Bonferroni correction, the new statistical critical value will be p = 0.006 for these comparisons. In this case, the Fisher's exact test results were presented for some of the pair-wise comparisons due to some of the expected counts being lower than five.

Table 4.7 - Chi-squared, Fisher's exact test (FET), and *p*-values for pair-wise comparisons between the females in each of the collections.

Comparison		χ^2 value	*p*-value
St Benet	Chelsea	2.727	0.143
St Benet	Kingston	FET	0.182
St Benet	BGL	3.327	0.099
St Benet	St Bride	**8.241**	**0.005**
St Benet	Cross Bones	FET	0.658
St Bride	Chelsea	2.145	0.196
St Bride	Kingston	0.364	0.59
St Bride	BGL	4.010	0.048
St Bride	Cross Bones	2.667	0.124

The results presented in **bold** show the *p*-values that are statistically significant. The degree of freedom for each comparison is 1.

There is only one comparison that presents a statistically significant result. The collection from St Benet yields such a result when compared with St Bride (p = 0.005) and implies that chance variation did not contribute to the rates seen in each collection.

4.3.3 Standardised rate ratios

The rates were divided according to the individual collections in order to see if some collections are more likely to have females with a fracture than others.

Figure 4.7 illustrates the standardised rate ratios found between the females in the collections when analysed in pairs and when they were standardised using age.

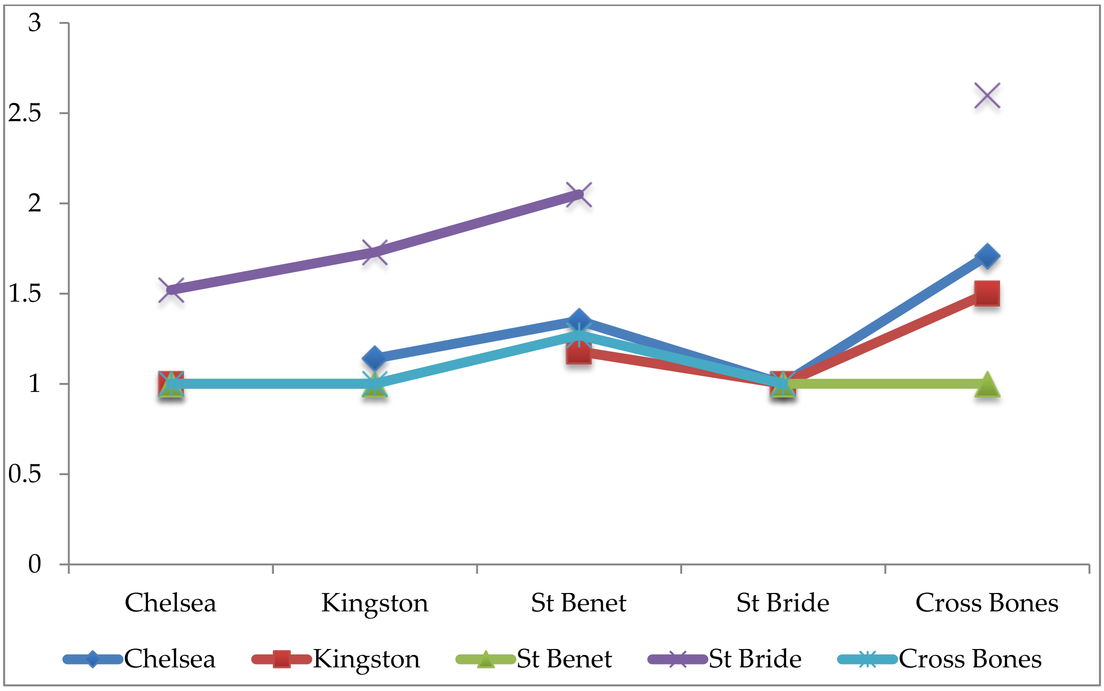


Figure 4.7 - Standardised rate ratios (SRR) for pair-wise comparisons between the females of each collection, standardised using age.

The highest rate ratio is found between St Bride and Cross Bones were the females from the former are 2.6 times more likely to have suffered a fracture than those from the latter burial ground. In regards to the statistically significant result, between St Bride and St Benet ($p = 0.005$), found above in Table 4.7, the corresponding odds state that the females from St Bride are 2.05 times more likely to have suffered a fracture over the course of their lifetime than if they had been exhumed from the St Benet burial ground. The ratio between Chelsea and Kingston, where the females from Chelsea are 1.14 times more likely to have suffered a fracture, is the lowest ratio found in the female sample. Once again, St Benet is always less likely than any other burial ground included in the current project to have an individual with a fracture. The ratios for each pair-wise comparison of the female skeletal collections can be found in section 3.1.3.2 of Appendix 3.

4.4 Comparison between the sexes

4.4.1 Prevalence rates

Since the analysis has been performed according to each sex, they will now be compared to see if one sex has a higher crude prevalence rate than the other. Table 4.8 shows the total number of individuals, as well as the number of individuals exhibiting a fracture, for each sex.

Table 4.8 - The total number of individuals, as well as the number of individuals with a fracture (N.F), for each sex.

	Total number of individuals	N.F
Male	718	241
Female	405	88
Total	1268	343

Figure 4.8 reveals that the males have a higher crude prevalence rate (33.57%) than the females (21.73%).

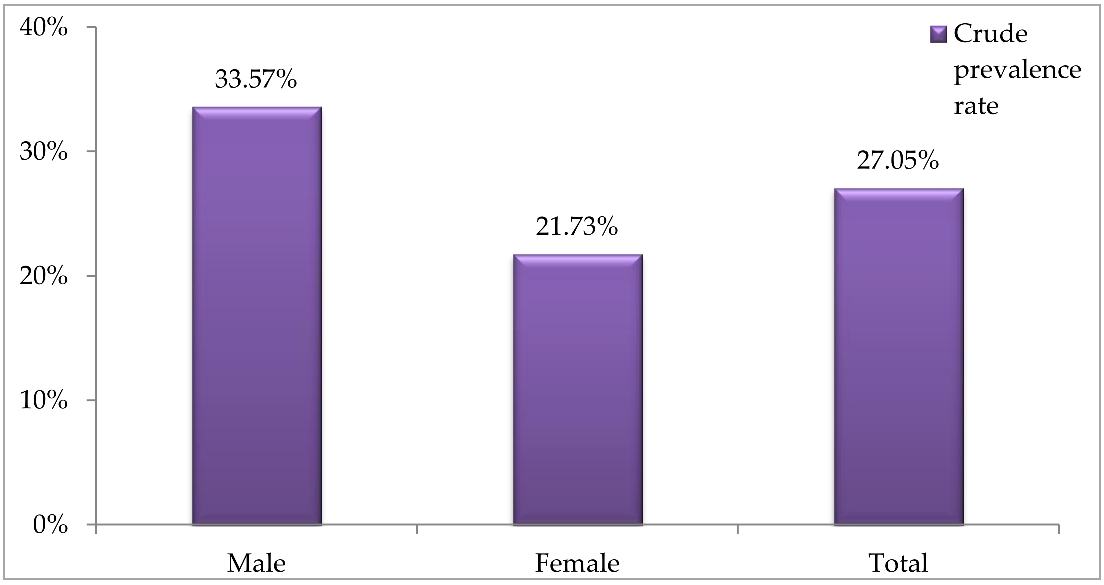


Figure 4.8 - The crude prevalence rates for the individuals with a fracture in the male and female populations as well as the total number of individuals.

4.4.2 Chi-squared test results

The data used for the following chi-squared test is presented in Tables 4.4 and 4.6 and the test was performed in order to compare the males and females in the sample. The data for each collection was imputed into one test (Appendix 3, section 3.1.2); accordingly, it is possible to observe the outcomes for the total number of individuals in the collective sample, as well as any differences between the sexes seen in the individual collections. When observing the collective sample it was found that the difference seen between the sexes are statistically significant ($\chi^2 = 17.591$, df = 1, $p < 0.001$).

The results were also given for each collection since the test was layered according to the individual burial grounds. The results from St Bride ($\chi^2 = 4.961$, df = 1, $p = 0.032$) and Bowling Green Lane ($\chi^2 = 9.483$, df = 1, $p = 0.002$) were also found to be statistically significant when comparing the sexes.

4.4.3 Standardised rate ratios

When the male and female individuals were compared and standardised according to age, it was found that the males in the collective sample were 1.39 times more likely to exhibit a fracture than their female counterparts. This supports the hypothesis found in section 3.1.2.1 of Chapter 3 postulating that the male skeletons in the sample will have more fractures than the female skeletons.

The males and females were also compared within their respective collections. The individuals from Chelsea, St Bride and Cross Bones present an outcome that is reflective of what was seen when the collections were grouped together. The males from Chelsea are 1.15 times, the ones from Cross Bones are 1.97 times, while those from St Bride are only 1.01 times more likely to exhibit a fracture than their female counterparts in their respective collections. On the other hand, the collections from Kingston and St Benet present the opposite outcome. Kingston's females are 1.07 times and the ones from St Benet are 1.16

times more likely to have suffered a fracture than the males from the same burial ground. Therefore, these two burial grounds contradict the above hypothesis when the results are further broken down into the individual collections. The ratios found between the sexes are illustrated in Figure 4.9.

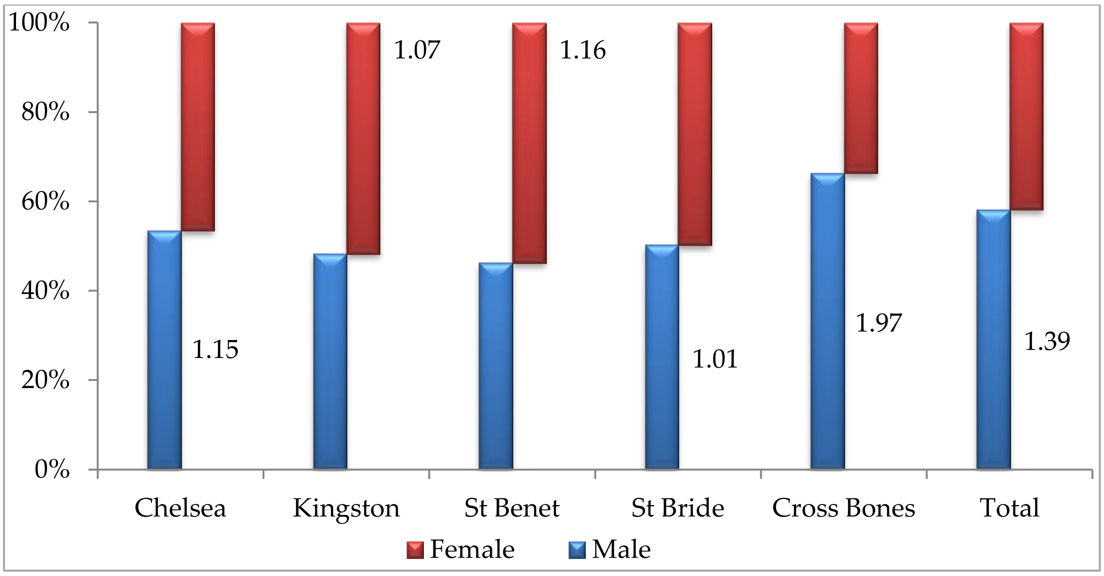


Figure 4.9 - The standardised rate ratios between the sexes for each collection indicating the highest value in each comparison.

4.5 Young Adults

In the following section, including the subsequent sections on middle and old adults, the collection from Bowling Green Lane was removed from the analysis due to the limitations explained in section 3.3.1.2 of Chapter 3.

4.5.1 Prevalence rates

Table 4.9 exhibits the total number of young adults (YA) in the skeletal sample, as well as the number of individuals with a fracture in this age category. The highest number of YA with a fracture is found in the collection from St Bride (n = 15) while the lowest number is from Kingston (n = 1).

Table 4.9 - The total number of YA, as well as the number of YA with a fracture (N.F), for each collection.

Burial ground	Total number of YA	N.F
Chelsea	49	9
Kingston	6	1
St Benet	56	5
St Bride	76	15
Cross Bones	11	2
Total	197	32

St Benet once again displays the lowest crude prevalence rate with 8.93% of the YA population having suffered a fracture (Figure 4.10), and the highest rate (19.74%) is found within the YA population of St Bride. Furthermore, Kingston's rate (16.67%) is very close to that of the total number of YA (16.24%).

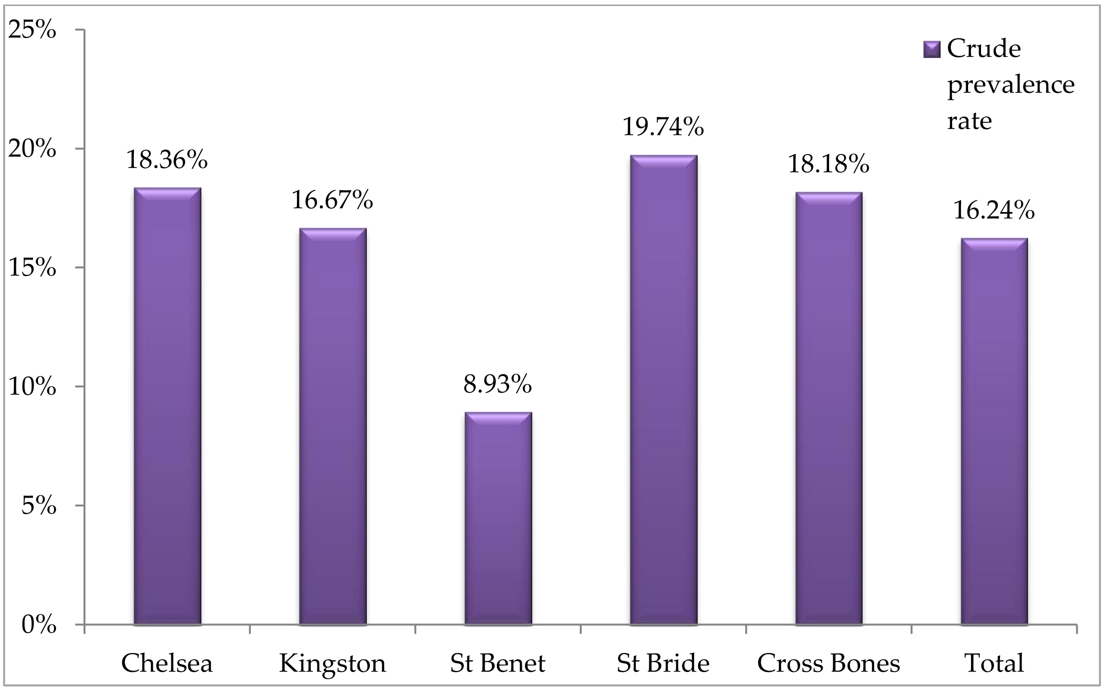


Figure 4.10 - The crude prevalence rates for the YA with a fracture for each collection and for the total number of YA.

4.5.2 Chi-squared test results

The data for every age category, divided according to each collection were inputted into one chi-squared test. When observing the results, the outcome for the YA is peculiar; the results are invalid and cannot be presented (Appendix 3, section 3.2.1). This is due to the fact that 20% of the expected counts are lower than five and the minimum expected count is less than one. As a result, both the chi-squared and Fisher's exact test are not applicable. Consequently, for this particular age category, there is no statistical test result to present.

4.5.3 Standardised rate ratios

While the result of the statistical test above may not have been presentable, it is still worth exploring which collection was more likely to have a young adult with a fracture. Table 4.10 illustrates the standardised rate ratios found between the collections when they are analysed in pairs and standardised using sex. In this case, the lone YA from Kingston who exhibits a fracture is an unsexed young adult. As a result, this individual is not included in the standardised rate ratios due to only individuals with determinable age and sex estimations being included in these calculations. Hence, there are no YA males or females with a fracture in this particular collection and this produces invalid results for Kingston and is indicated by "n/a" in Table 4.10.

Table 4.10 - Standardised rate ratios (SRR) for pair-wise comparisons between the YA of each collection, standardised using age.

	SRR	**Compared with**
Chelsea	n/a	Kingston
Chelsea	1.94 : 1	St Benet
Chelsea	1 : 1.05	St Bride
Chelsea	1.07 : 1	Cross Bones
Kingston	n/a	St Benet
Kingston	n/a	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 2.05	St Bride
St Benet	1 : 2.08	Cross Bones
St Bride	1 : 1.02	Cross Bones

In this age category, the highest ratio is not found between St Benet and St Bride, yet it still happens to be the second highest ratio that is seen in the YA sample. For this sample, the highest ratio indicates that the individuals from Cross Bones are 2.08 times more likely to have suffered a fracture than if they had come from the St Benet burial ground. Cross Bones also has the lowest ratio where it is only 1.02 times more likely to have a YA with a fracture than St Bride.

4.6 Middle Adults

4.6.1 Prevalence rates

The crude prevalence rates were re-calculated for the middle adults (MA) in the skeletal sample. In this case, St Bride has the highest number of MA with a fracture with a total number of 41, while Kingston (n = 2) has the lowest (Table 4.11).

Table 4.11 - The total number of MA, as well as the number of MA with a fracture (N.F), in each collection.

Burial ground	Total number of MA	N.F
Chelsea	43	10
Kingston	10	2
St Benet	38	8
St Bride	118	41
Cross Bones	17	7
Total	224	68

This age category does not follow the pattern that has emerged while looking at the sexes as well as when looking at the younger individuals in the sample. The resulting crude prevalence rates for the MA are found in Figure 4.11. The lowest rate for the MA deviates from St Benet, which typically is the bottommost collection, and is found within the MA individuals from Kingston with a rate of 20%. However, the rate of MA with a fracture from St Benet is a close second with 21.05%. Unlike all the previous subdivisions where the highest rate is associated with St Bride, the highest rate (41.18%) of MA with a fracture is found within the population of Cross Bones.

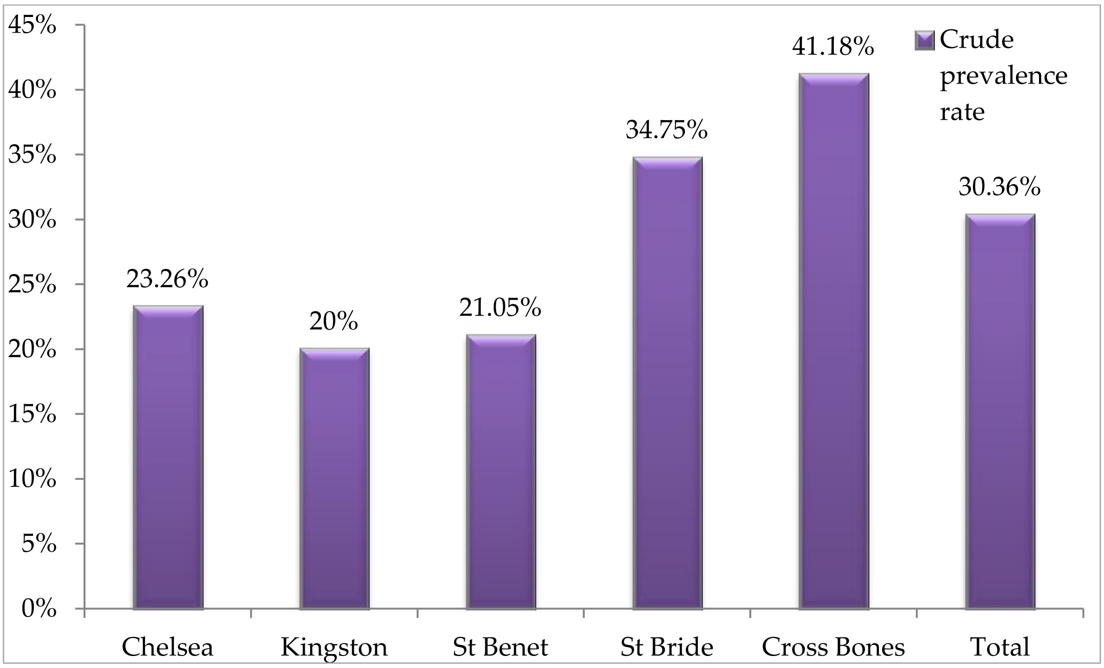


Figure 4.11 - The crude prevalence rates for the MA with a fracture for each collection and for the total number of MA.

4.6.2 Chi-squared test results

When the differences are observed between the collections for the MA sample, it was found that they are not statistically significant ($\chi^2 = 2.798$, df = 4, $p = 0.075$). Since only 10% of the expected counts were lower than five and the minimum was well above one, the results were permissible (Appendix 3, section 3.2.1).

4.6.3 Standardised rate ratios

Similarly to what was done in section 4.5.3 found above, the standardised rate ratios were still calculated for the MA in the collections even though the statistical test was insignificant for the collective MA sample's data. Figure 4.12 illustrates the rate ratios found between the collections when analysed in pairs and standardised using sex.

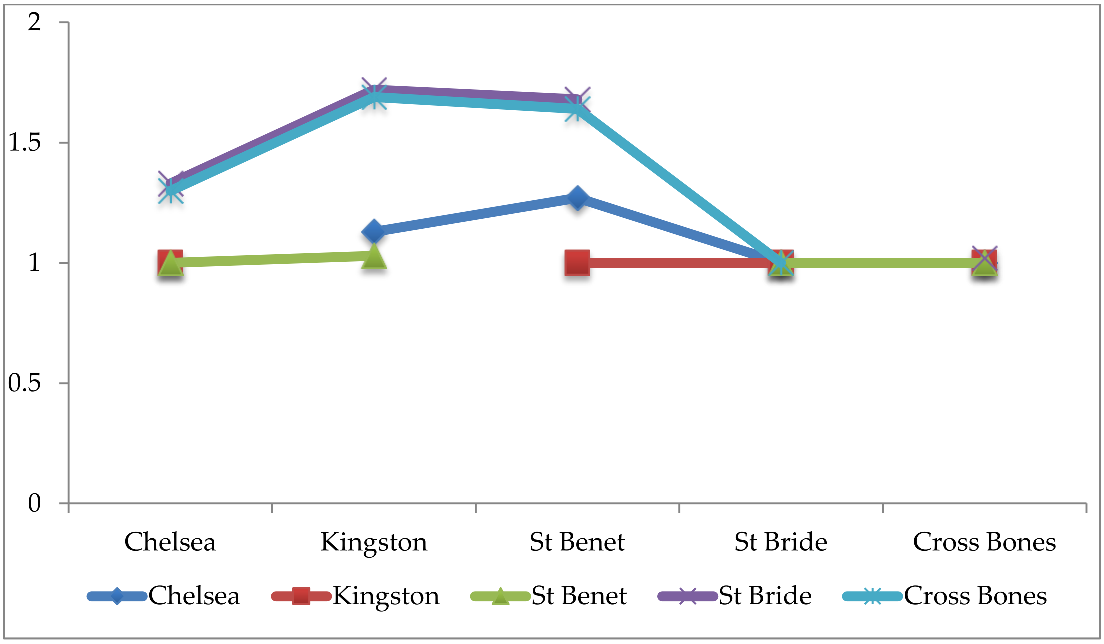


Figure 4.12 - Standardised rate ratios (SRR) for pair-wise comparisons between the MA of each collection, standardised using age.

The MA differ once again from the previous subdivisions as the highest rate ratio is not found to be between St Bride and St Benet. Evidently, the highest ratio, which is not very high at all, indicates that the MA from St Bride are 1.72 times more likely to have a fracture than those from Kingston. The ratio between St Bride and Cross Bones, where the MA from St Bride are only 1.02 times more likely to have suffered a fracture, is the lowest.

Incidentally, this is the first instance noted so far where individuals from St Benet are more likely to have a fracture than another collection. It is not a large difference but the MA from St Benet are 1.03 times more likely to have suffered a fracture as opposed to those from Kingston. All the ratios seen in Figure 4.12 are rather small as none of the collections are even twice as likely as another to have a MA with a fracture. The ratios for every middle adult pair-wise comparison can be also found in section 3.2.3.1 of Appendix 3.

4.7 OLD ADULTS

4.7.1 Prevalence rates

In the population of older individuals, the lowest number of old adults (OA) with a fracture (n = 2) is found within Cross Bones, while St Benet, which has habitually been the lowest, follows closely behind (n = 3). However, the OA follow the pattern pertaining to the highest observed number (n = 51) which is associated with St Bride. Table 4.12 exhibits the numbers of OA with a fracture for all the collections as well as for the collective OA sample.

Table 4.12 - The total number of OA, as well as the number of OA with a fracture (N.F), for each collection.

Burial ground	Total number of OA	N.F
Chelsea	43	15
Kingston	18	6
St Benet	18	3
St Bride	75	51
Cross Bones	14	2
Total	168	77

The crude fracture prevalence rates seen for the OA population exhibiting a fracture are some of the highest rates seen in this chapter. Considering that the rates for the individuals with a fracture found in the YA population are all under 20%, having four results out of six well above that amount is noteworthy (Figure 4.13). Cross Bones has the lowest rate at 14.29% with St Benet being a close second with 16.67%. The OA population returns to the norm as its highest rate (68%) is also found within the population of St Bride. This is the highest fracture prevalence rate that has been seen so far when separating the collective sample according to the sexes and the age categories.

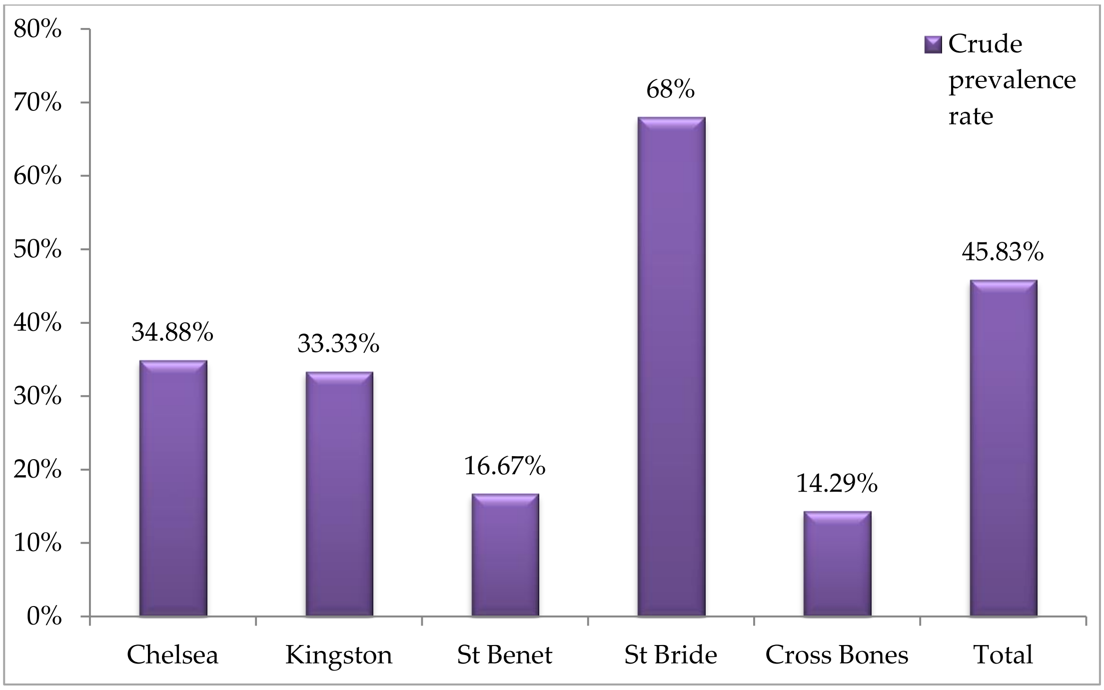


Figure 4.13 - The crude prevalence rates for the OA with a fracture for each collection and for the total number of OA individuals.

4.7.2 Chi-squared and Fisher's exact test results

The same test that revealed the results in sections 4.5.2 and 4.6.2 found above is once again consulted in order to retrieve the results for the OA. The results revealed that the differences seen between the OA in each collection are statistically significant ($\chi^2 = 11.604$, df = 4, $p < 0.001$) (Appendix 3, section 3.2.1).

As a result, the data was further broken down so that the collections could be compared as pairs (i.e. *post hoc* tests) in order to see which collections contribute to that significant result. The collections from St Bride and Cross Bones, which represent the highest and lowest crude fracture prevalence rates, respectively, were compared with the other collections. The Bonferroni correction was applied and as seven additional comparisons were made, the statistical critical value becomes $p = 0.007$ for Table 4.13. Some of the comparisons had expected counts lower than five; as a result, the Fisher's exact test results are presented. None of the new results were statistically significant.

Table 4.13 - Chi-squared, Fisher's exact test (FET), and *p*-values for pair-wise comparisons between the OA in each of the collections.

Comparison		χ^2 value	*p*-value
St Bride	Chelsea	3.688	0.069
St Bride	Kingston	2.049	0.175
St Bride	St Benet	5.313	0.027
St Bride	Cross Bones	4.75	0.052
Cross Bones	Chelsea	FET	0.332
Cross Bones	Kingston	FET	0.439
Cross Bones	St Benet	FET	1.00

The degree of freedom for each comparison is 1.

4.7.3 Standardised rate ratios

The rates were divided according to the individual collections in order to see if some collections are more likely to have OA with a fracture than others. Figure 4.14 illustrates the standardised rate ratios found between the collections when analysed in pairs and standardised using sex.

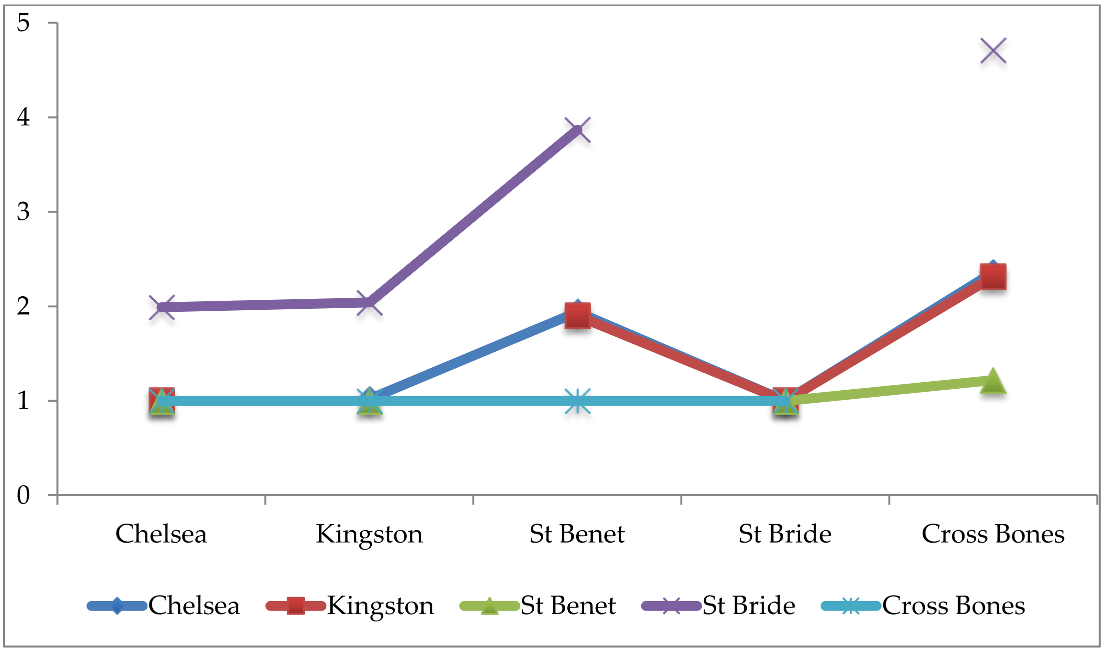


Figure 4.14 - Standardised rate ratios (SRR) for pair-wise comparisons between the OA of each collection, standardised using age.

The OA population again diverges from the pattern seen over the course of this chapter, but only slightly. Instead of the highest ratio being between St

Bride and St Benet, where St Benet is less likely to have an individual with a fracture, St Bride is now 4.71 times more likely to have an OA who suffered a fracture compared to the OA from Cross Bones. In this case, when the other collections are compared with Cross Bones, they will always be more likely than Cross Bones to have an individual who suffered a fracture. In the previous sex and age delineations, St Benet was more often than not the collection that was less likely than all the others to exhibit an individual with a fracture. The ratio between Chelsea and Kingston, where the OA from Chelsea are only 1.02 times more likely to have suffered a fracture, is the lowest seen for the collective OA sample. The ratios for every pair-wise comparison can be found in section 3.2.3.2 of Appendix 3.

4.8 COMPARISON BETWEEN THE AGE CATEGORIES

Once the results were calculated for each individual age category, they were re-analysed in order to cross-compare them. It was possible to compare the three age categories with the rate from the collective sample. Furthermore, the sample was broken down so that the age categories could be compared in pairs.

4.8.1 Prevalence rates

Table 4.14 shows that the number of individuals with a fracture increases as the age categories progress. When looking at the collective sample, it appears that age will be a factor in the increasing amount of fractures an individual will suffer over the course of their lifetime. The corresponding crude fracture prevalence rates can be seen in Figure 4.15.

Table 4.14 - The total number of individuals, as well as the number of individuals with a fracture (N.F), in each age category.

	Total number of individuals	N.F
YA	198	32
MA	228	68
OA	168	77
Total	594	177

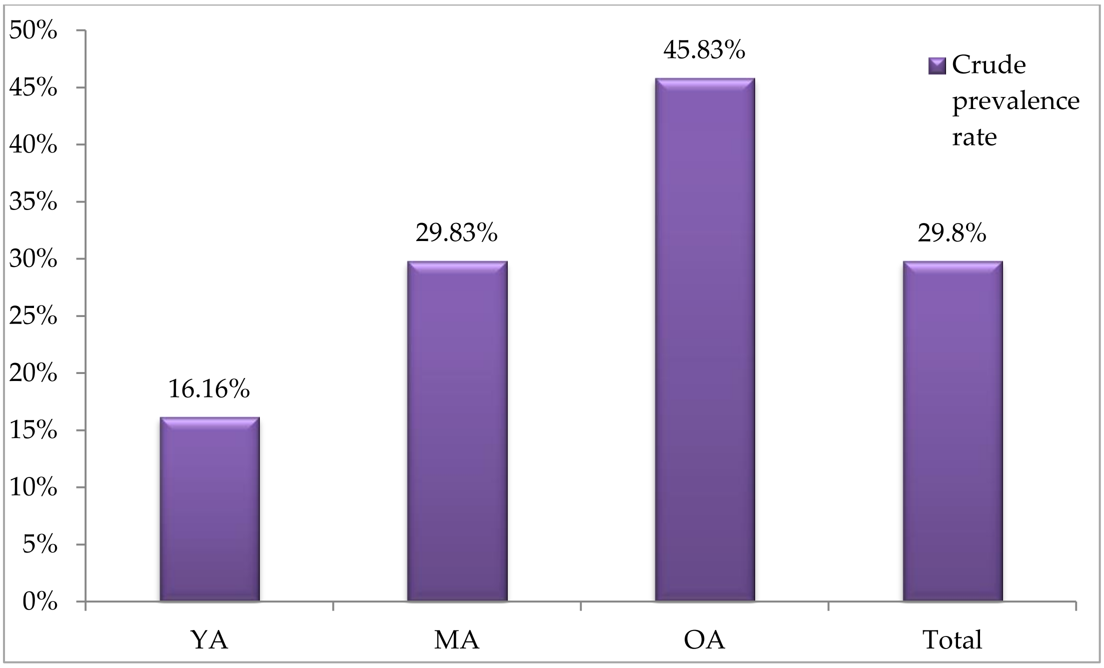


Figure 4.15 - The crude prevalence rates for the individuals with a fracture in the different age categories as well as the whole sample.

Interestingly, there are a few exceptions to what was seen above when the crude prevalence rates for each age category were divided among the individual burial grounds (Figure 4.16). Those exceptions can be seen in the population from St Benet and Cross Bones where the MA have a higher fracture prevalence rate than the OA in their respective burial grounds.

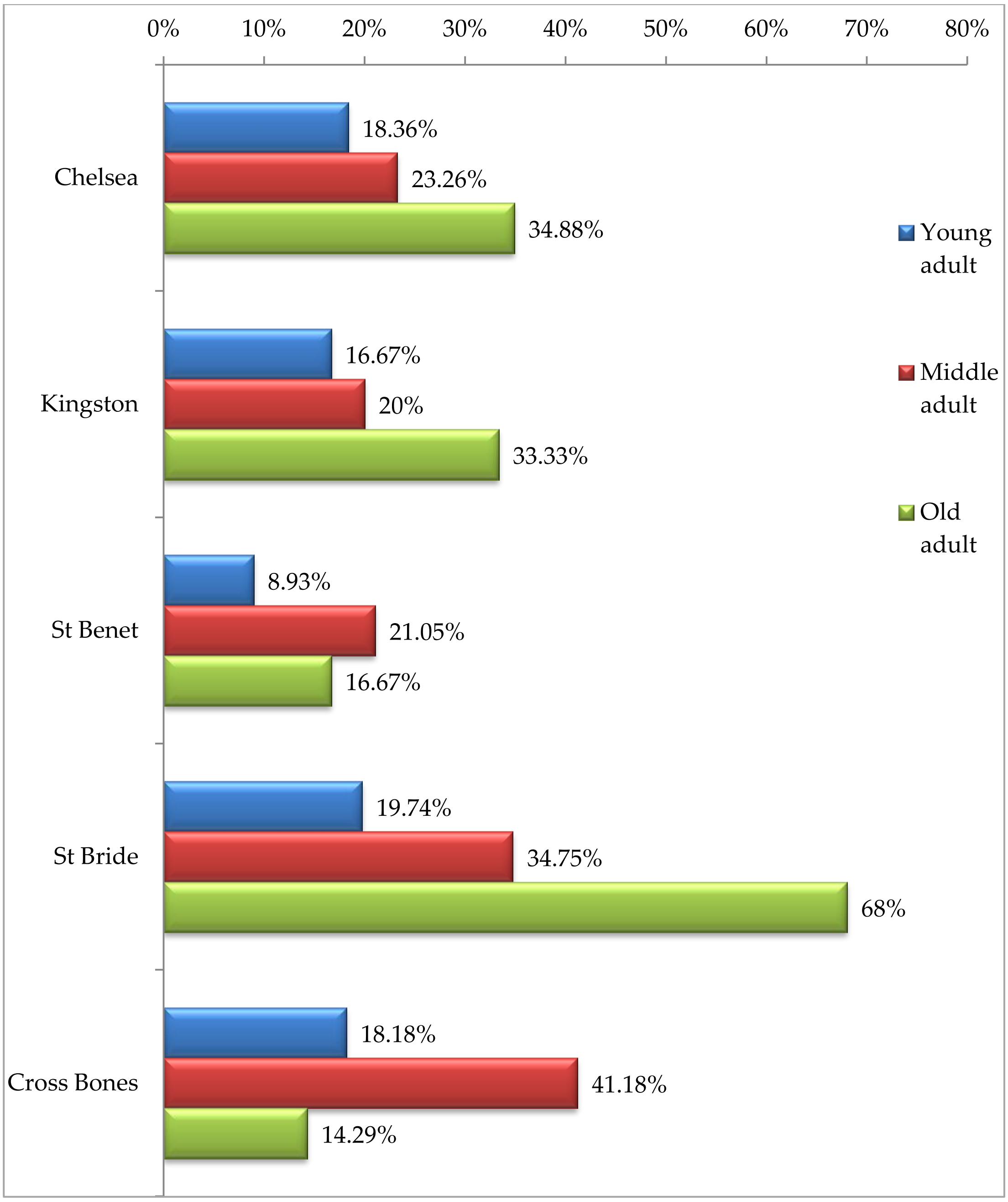


Figure 4.16 - The crude fracture prevalence rates for each age category in each collection.

4.8.2 Chi-squared test results

The data from each age category (found in Tables 4.9, 4.11 and 4.12) were inputted into one test in order to examine the different rates seen in each age category and compare them (Appendix 3, section 3.2.2). The test was layered according to the age categories. The chi-squared results indicated that the differences seen between the rates of individuals with a fracture seen in each age category is statistically significant ($\chi^2 = 20.544$, df = 2, $p < 0.001$).

It was also found that the difference between the age categories was significant in St Bride ($\chi^2 = 15.906$, df = 2, $p < 0.001$). All other comparisons between the age categories when looking at the individual collections were statistically insignificant.

4.8.3 Standardised rate ratios

When looking at the whole sample, it was found that the OA are 2.88 times more likely than the YA, and 1.55 times more likely than the MA to have an individual with a fracture. Furthermore, the individuals from the MA age category are 1.86 times more likely to have an individual with a fracture than the YA. These ratios support the hypothesis presented in section 3.1.2.5 of Chapter 3 stipulating that the older individuals in the sample will present a larger number of fractures compared to their younger counterparts.

The age categories were then divided amongst their respective burial grounds in order to see if the same pattern seen in the collective sample will be revealed in each collection. The collection from Chelsea follows the same pattern as above where the OA are 1.78 times more likely than the YA and 1.3 times more likely than the MA to have an individual with a fracture. Furthermore, the MA are 1.37 times more likely to have an individual with a fracture than the YA.

The collection from Kingston did not exhibit any YA with fractures, which were sexed as being either male or female, and as a result it cannot be compared with the MA or the OA with standardised rate ratios. However, the OA are 1.66 times more likely to have a fracture than the MA in the collection from Kingston.

The population from St Benet follows a different pattern than Chelsea and the collective sample. In this collection, the MA are 2.19 times more likely than the YA and 1.19 times more likely than the OA to have fractures. This is the opposite of what is seen above where the OA are always more likely to have fractures than the other two age categories and evidently refutes the aforementioned hypothesis related to the augmenting number of fractures as the age categories progress. Yet, the OA are still 1.83 times more likely than the YA from St Benet to have an individual with a fracture in this age category.

The sample from St Bride sees a return to the norm where the OA are 3.45 times more likely than the YA and 1.99 times more likely than the MA to have suffered a fracture. The MA are also 1.73 times more likely than the YA to exhibit a fracture.

Finally, the collection from Cross Bones presents results similar to St Benet and also opposes the above hypothesis. In this case, the OA are never more likely to have suffered a fracture when compared with the other age categories. The MA are 2.06 times more likely than the YA and 2.63 times more likely than the OA to suffer a fracture over the course of their lifetime. And surprisingly, the YA are 1.28 times more likely than the OA to have an individual from that age group to have a fracture.

Summary

The results presented in this chapter begin to explore an avenue of possibilities regarding life experiences in relation to risks of skeletal injury in 18th- and 19th-century London. In this first chapter covering the results, all the fractures in the sample are explored without focusing on their specific location on the body. This general overview of the presence of fractures allows for a broad understanding of the dispersion of fractures among the sexes, age categories and urban locations. From the aforementioned results, certain fracture patterns arise between the collections especially relating to the collections presenting the highest and lowest fracture prevalence rates, for example.

When observing the fractures seen on the collective sample, regardless of the individuals' age or sex, it was found that St Benet displays the lowest fracture prevalence rate while St Bride has the highest. When the collections were divided according to sex, St Benet and St Bride also displayed the lowest and highest rates, respectively, for both the males and females. When observing the different age categories, the young adults present that same pattern. However, the situation is different when observing the middle and old adults. The middle adults find their lowest fracture prevalence rate in the population from Kingston and their highest from Cross Bones. Interestingly, when analysing the old adults, the collections change once again. In this case, the highest prevalence rate is once again seen in the collection from St Bride yet the lowest rate is associated with the individuals from Cross Bones.

As for the statistical tests that were computed, the differences between the collections were statistically significant when observing the collective sample as well as the male and female sample. When exploring the significant result for the collective sample, *post hoc* tests revealed a significant result when comparing St Bride with St Benet and when each of these collections were compared with Chelsea and Bowling Green Lane, respectively. The comparisons for each sex as well as for the individual age categories yielded significant statistical results with the exception of the YA and the MA. The test of the MA was simply statistically insignificant while the test for the YA was not permissible due to an insufficient number of expected counts over the value of five.

The *post hoc* tests were significant when observing the comparison between St Benet and St Bride as well as St Benet and Bowling Green Lane for the males in the sample. Furthermore, for the females, the *post hoc* test for St

Benet and St Bride was also significant. When the sexes were compared, the males' and females' data, stemming from each collection as well as from the collective sample, were all inputted into one statistical test. As a result, it was determined, without the necessity of *post hoc* tests that the difference between the sexes in the collective sample was significant as well as the comparison between the sexes in St Bride and Bowling Green Lane. The same was executed for the three age categories and the statistical tests were significant for the collective sample as well as when the individuals are from the St Bride burial ground. As a result, when observing all the chi-squared tests in this chapter, the statistical significance of the comparison between St Bride and St Benet is a recurring theme.

Furthermore, when observing the odds ratios and standardised rate ratios, certain pattern began to emerge. The collection from St Benet was always less likely than any other collection to have an individual who exhibited fractures when observing the collective sample, the males, the females as well as the young adults. However, the middle and old adults present a different outcome. In regards to the MA, the individuals from Kingston were always less likely to have suffered a fracture over the course of their lifetime. As for the OA, this was true for the collection from the Cross Bones burial ground.

When the ratios for the sexes were compared, it was found that the males were 1.39 times more likely to have a fracture than if they were female. The comparison of the sexes in each collection delivered the same outcome with the exception of Kingston and St Benet. In both cases, the females in these burial grounds were more likely to have suffered a fracture during their lifetime than if they were males. When observing the age categories, the OA were more likely than both the MA and the YA, much more so when compared to the YA, to have individuals with at least one fracture. Since the older adults have lived a larger number of years, anthropologically and epidemiology speaking, they should have more fractures than those from the middle or young adult age categories (Larsen 1997: 118; Mays 1998: 176; Roberts 2000: 345).

As mentioned in section 3.3.1.1 of Chapter 3, when a fracture occurs on a adult skeleton, it can very well leave evidence that will be visible for most of an individual's lifetime (Mays 1998: 176). Since the project is focused on ante-mortem fractures seen on dry bone (section 3.4.2 of Chapter 3), the older individuals should be more likely to have fractures than the other age categories. However, when the individual collections were analysed to see if the age categories followed the same pattern, St Benet and Cross Bones presented different results. For the individuals from St Benet, the MA are more likely than both the YA and OA to have more fractures. As for the individuals from Cross Bones, the MA reflect the same outcome as in St Benet. Furthermore, the YA from Cross Bones are more likely than the OA to have suffered a fracture during their lifetime. As a result, these two collections not only present a different outcome than what was seen in previous groups but also they do not follow the aforementioned anthropological and epidemiological notion.

Now that a general overview of the presence of fractures has been presented, it is possible to explore in more detail the anatomical location of such fractures and the patterns they reveal.

Chapter 5
Results – Fractures by anatomical area

The previous chapter has demonstrated that fractures were present in both sexes and within all age categories in every skeletal collection under study. Now that a general overview of the presence of fractures in London during the eighteenth and nineteenth centuries has been presented, it is possible to delve deeper into the anatomical location of such fractures and begin to understand the revealed fracture patterns.

This chapter focuses on where the fractures are located on the body. This is a first step in determining the possible presence of interpersonal violence which will be fully explored in the following chapter. Commencing with the observation of the fractures' location on the body can reveal who may have been more susceptible to fractures in certain locations and if age and sex were correlated to the outcome. In order to do so, the body is divided into six anatomical areas: the skull, the torso, the upper limbs, the hands, the lower limbs and the feet. The bones included in each anatomical area have been previously presented in section 3.4.3 of Chapter 3.

In this chapter, all the statistical tests were conducted with the true prevalence rates rather than the crude rates used in the previous Results chapter. When inputting the data in SPSS, an individual could only fall into the "without a fracture" category if they had a bone present which was located in the specific anatomical area of interest. As a result, Bowling Green Lane is removed from any statistical tests. However, when observing the crude and true prevalence rates for each sex and age category, the crude rates for Bowling Green Lane are presented.

5.1 COLLECTIVE SAMPLE

5.1.1 Prevalence rates

As seen in section 4.1 of Chapter 4, this section covers the collective sample regardless of the individual's age or sex. The aim here is to explore the total number of individuals with a fracture in each anatomical area to see how the fractures are distributed on the body. Table 5.1 presents the number of individuals with a fracture found for each anatomical site. Since this table presents the number of individuals with a fracture in each anatomical area regardless of which burial ground the individuals came from, the individuals from Bowling Green Lane are included in this table. A proper presentation of the number of individuals in each collection with a fracture according to each anatomical area is presented below in Table 5.2.

Table 5.1 - The number of individuals with a fracture for each anatomical area, including the individuals from Bowling Green Lane.

Bone	Individuals with a fracture
Skull	71
Torso	184
Upper	74
Hands	35
Lower	72
Feet	29

When observing the fractures' location according to each anatomical area, two crude prevalence rates were calculated (Figure 5.1). First, the rate for fractures in each anatomical area was calculated based on the collective sample which includes the individuals who do not exhibit a fracture (n = 1268). Afterwards, the sample, from which the crude rate was calculated, was limited to the total number of individuals with a fracture (n = 343).

The highest crude prevalence rates are seen in the torso with 14.51% of individuals in the collective sample having a fracture in this location; when looking at the total number of individuals with a fracture, more than half (53.64%) of the 343 individuals categorised as such have a fracture that is located on the torso. When looking at the lowest crude rates for the collective sample, as well as the rates for the sample of individuals with a fracture, they are both found in the feet with 2.29% and 8.46%, respectively.

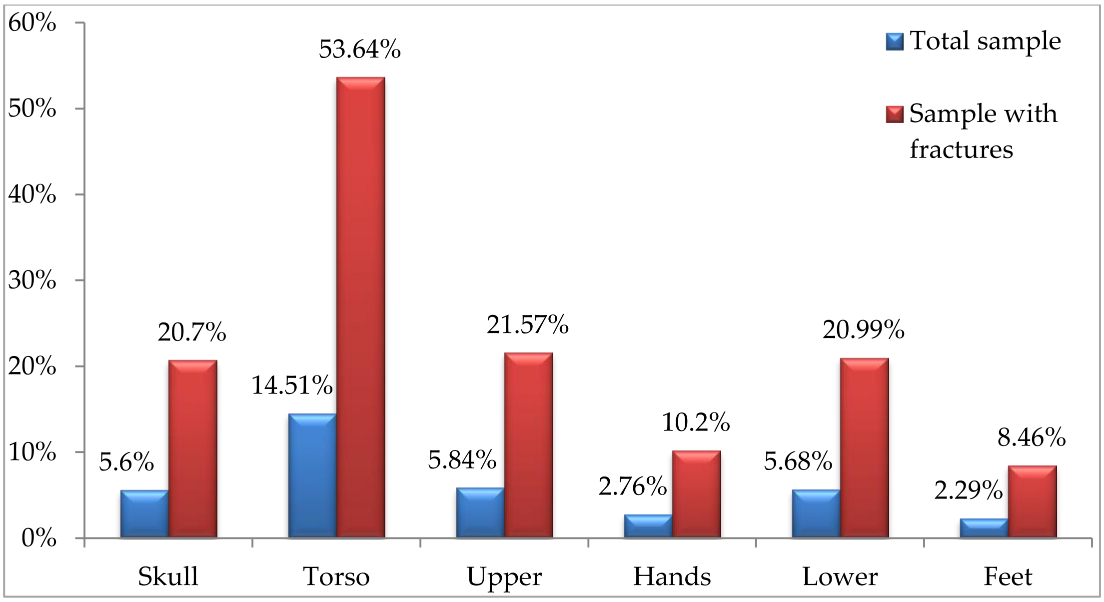


Figure 5.1 - The crude prevalence rates for the collective sample (n = 1268) and the sample of individuals with a fracture (n = 343).

Table 5.2 presents the same information that is found in Table 5.1; however, the numbers are divided according to each individual collection and they depict a much more detailed interpretation of the data that could not be seen in Table 5.1. In the table below, the crude prevalence rate, the number of individuals with at least one bone present in the area, and the true prevalence rates are presented for each anatomical area.

Table 5.2 - The number of individuals with a fracture (N.F), the number of individuals with a bone present in each anatomical area, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	Individuals with bone present	True prevalence rate
Chelsea (n = 165)				
Skull	6	3.64%	113	5.31%
Torso	13	7.88%	131	9.92%
Upper	8	4.85%	149	5.34%
Hands	5	3.03%	134	3.73%
Lower	9	5.45%	142	6.34%
Feet	5	3.03%	101	4.95%
Kingston (n = 42)				
Skull	0	0%	40	0%
Torso	2	4.76%	38	5.26%
Upper	6	14.29%	39	15.39%
Hands	0	0%	31	0%
Lower	2	4.76%	41	4.88%
Feet	1	2.38%	36	2.78%
Bowling Green Lane (n = 492)				
Skull	25	5.08%	n/a	n/a
Torso	81	16.46%	n/a	n/a
Upper	31	6.3%	n/a	n/a
Hands	11	2.24%	n/a	n/a
Lower	24	4.88%	n/a	n/a
Feet	11	2.24%	n/a	n/a
St Benet (n = 162)				
Skull	2	1.24%	102	1.96%
Torso	6	3.7%	130	4.62%
Upper	5	3.09%	133	3.76%
Hands	3	1.85%	129	2.33%
Lower	7	4.32%	140	5%
Feet	1	0.62%	117	0.86%
St Bride (n = 362)				
Skull	36	9.95%	284	12.68%
Torso	77	21.27%	339	22.71%
Upper	24	6.63%	320	7.5%
Hands	16	4.42%	291	5.5%
Lower	30	8.29%	276	10.87%
Feet	9	2.49%	201	4.48%

Table 5.2 cont. - The number of individuals with a fracture (N.F), the number of individuals with a bone present in each anatomical area, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	Individuals with bone present	True prevalence rate
Cross Bones (n = 45)				
Skull	2	4.44%	41	4.88%
Torso	6	13.33%	44	13.64%
Upper	2	4.44%	44	4.55%
Hands	1	2.22%	37	2.7%
Lower	3	6.67%	45	6.67%
Feet	2	4.44%	41	4.88%

Chelsea (9.92%), St Bride (22.71%) and Cross Bones (13.64%) all show the highest true rate to be within the torso. Bowling Green Lane's highest crude prevalence rate (16.46%) is also found in the torso. Kingston's highest true rate (15.39%) is representative of the upper limbs while St Benet's highest true rate (5%), which also happens to be the lowest of all the highest true rates, is found in the lower limbs. Figures 5.2 and 5.3 depict the true prevalence rates for each anatomical area according to each skeletal collection with the exception of Bowling Green Lane. In order to maintain fewer categories in Figure 5.2, the true rates were rounded up or down to the closest number. Figure 5.3 demonstrates how each collection compares to one another when separated according to the anatomical areas. Graphs for each skeletal collection depicting the crude and true rates for each anatomical area are presented in Appendix 4 (section 4.1.1).

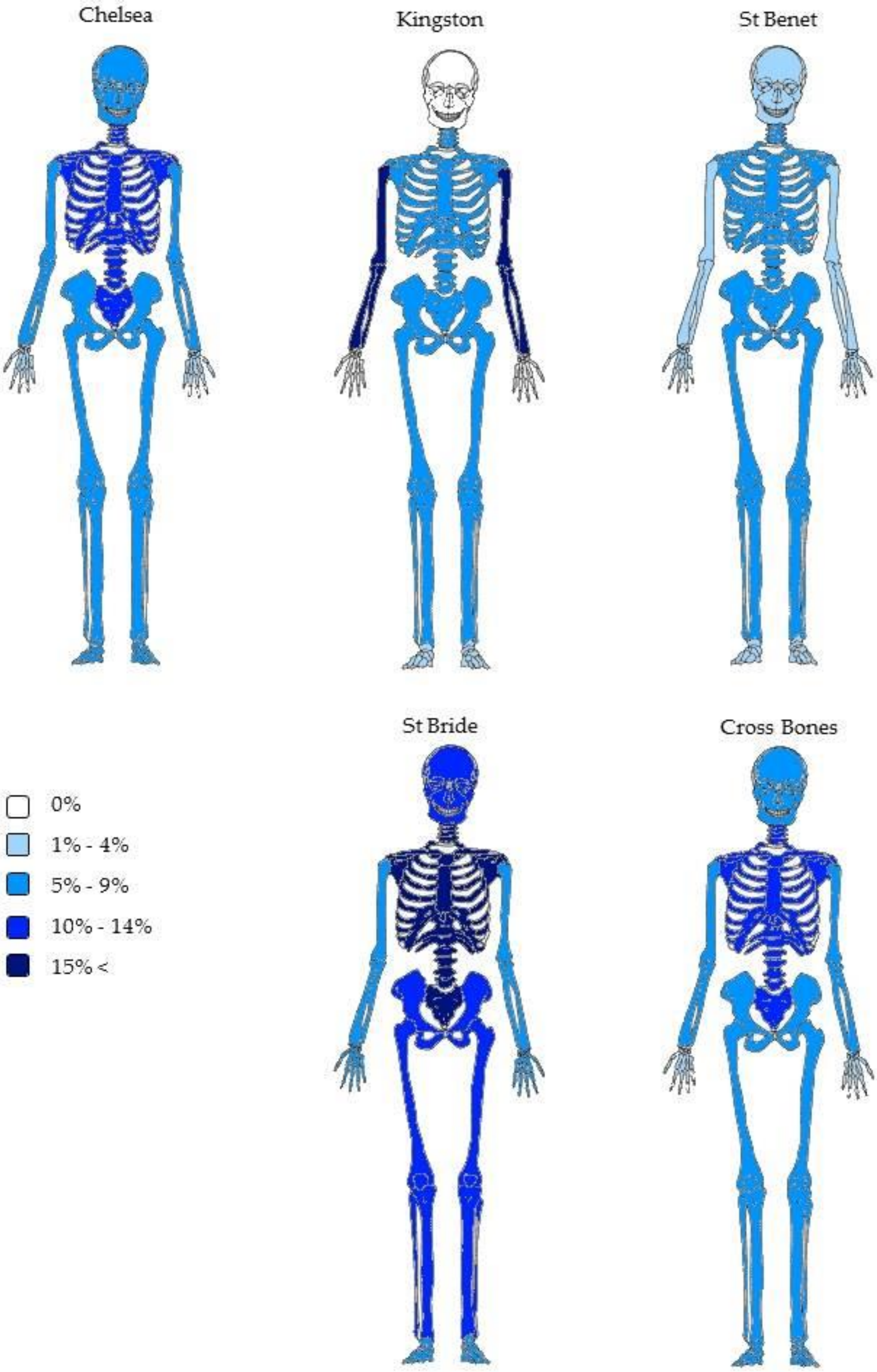


Figure 5.2 - The true fracture prevalence rates for each anatomical area according to each skeletal collection which the exception of Bowling Green Lane.

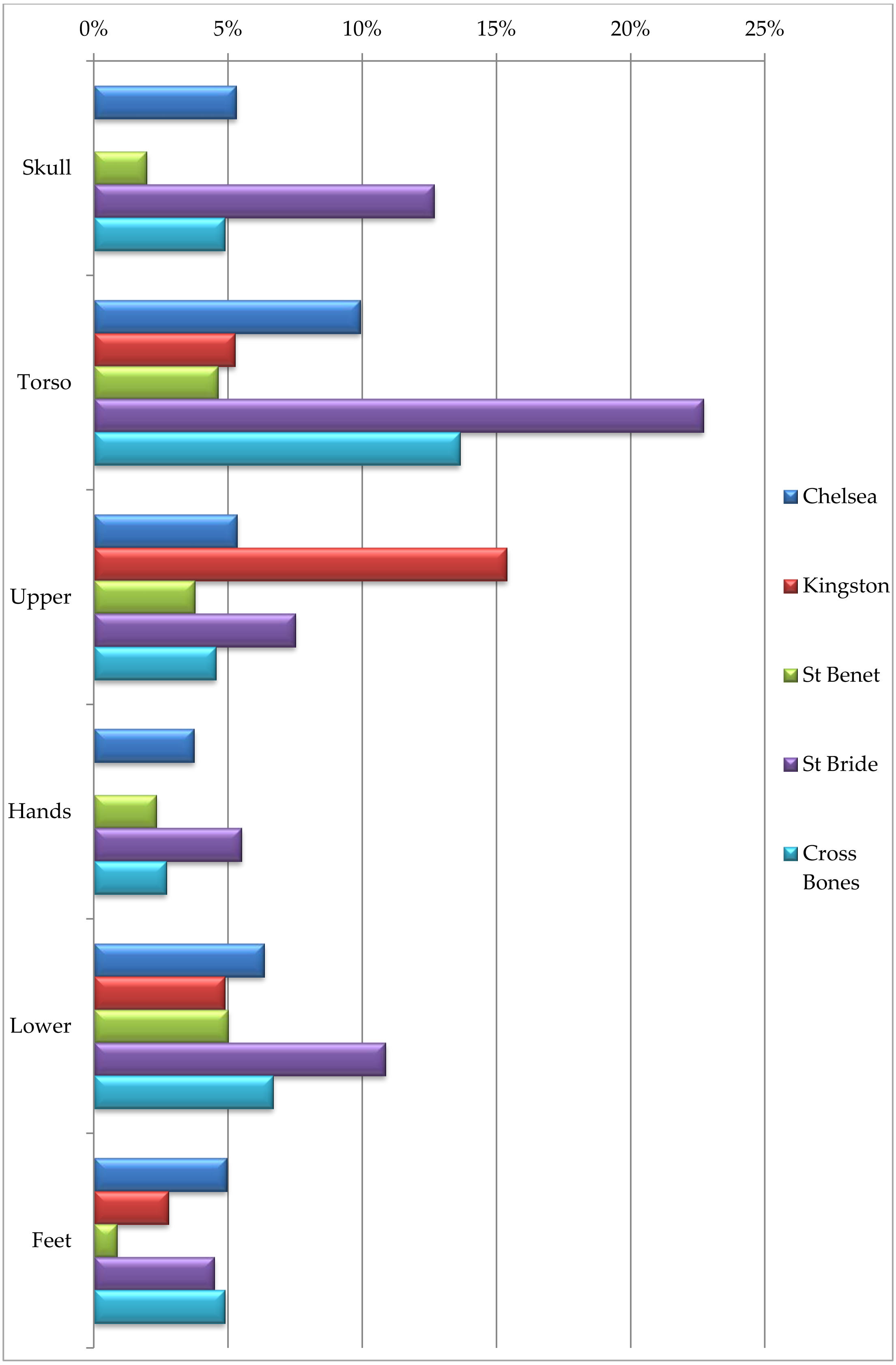


Figure 5.3 - The true prevalence rates for the anatomical areas seen in each collection, with the exception of Bowling Green Lane.

5.1.2 Chi-squared test results

As mentioned above, Bowling Green Lane will be omitted from any statistical test in this chapter due to the fact that the number of individuals with bones present in each anatomical area (i.e. true prevalence rates) was used rather than using the number of individuals in each collection (i.e. crude prevalence rates) in order to calculate the *p*-value. Further information regarding the data entry for the chi-squared test can be found in section 3.5.2 of Chapter 3.

When the test was computed, the data was entered so that the differences between the collections could be observed according to each anatomical area. The differences seen between the fracture prevalence rates from each burial ground was found to be statistically significant ($\chi^2 = 57.003$, df = 4, $p < 0.001$) when the anatomical areas were grouped together. The test also revealed that the differences seen between the burial grounds was statistically significant when looking at the relationship between the true prevalence rates for the fractures located on the torso ($\chi^2 = 31.886$, df = 4, $p < 0.001$). All other results were statistically insignificant (Appendix 4, section 4.1.2).

5.1.3 Odds ratios

As the collective sample was explored regardless of age or sex for this first section, the odds ratios will be calculated using the method taken from Field (2009), and described in section 3.5.3.1 of Chapter 3. The method found in Waldron (1994), which calculates standardised rate ratios through the indirect standardisation method, described in section 3.5.3.2 of Chapter 3, will be utilised when the data is divided according to sex and age, which begins in section 5.2.3.

The odds ratios were calculated for each anatomical area by comparing the burial grounds, even though the only area to produce statistically significant results was the torso. As a result, it is possible to clearly understand which area of the body is more affected when observing the various collections.

5.1.3.1 Skull

None of the individuals from Kingston had a fracture located on the skull; as a result, any ratio calculated with the data provided from this particular collection will be null and void. This is indicated with "n/a" in Table 5.3. The highest ratio found in the table indicates that the individuals from St Bride are 7.5 times more likely to have a fracture located on their skull than those from St Benet. The lowest ratio is found between Cross Bones and Chelsea where the former is only 1.2 times more likely to have suffered a fracture on this anatomical area during their lifetime than the latter.

Table 5.3 - The odds ratios for fractures on the skull for pair-wise comparisons between the individuals of each collection.

	Odds Ratios	Compared with:
Chelsea	n/a	Kingston
Chelsea	3 : 1	St Benet
Chelsea	1 : 2.5	St Bride
Chelsea	1 : 1.2	Cross Bones
Kingston	n/a	St Benet
Kingston	n/a	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 7.5	St Bride
St Benet	1 : 2.5	Cross Bones
St Bride	3 : 1	Cross Bones

5.1.3.2 Torso

It is important to note that these odds ratios are linked to comparisons between burial grounds that were found to be statistically significant. Individuals in every collection had fractures located on the torso; hence, comparisons were possible for every combination (Figure 5.4). The highest ratio indicates that the individuals from St Bride are 5.8 times more likely to have suffered a fracture on the torso than if they were interred within the St Benet burial ground. The lowest comparison is found between Kingston and St Benet where the individuals from the former are 1.2 times more likely to have a fracture at this location. The ratios for every pair-wise comparison can also be found in section 4.1.3.1 of Appendix 4.

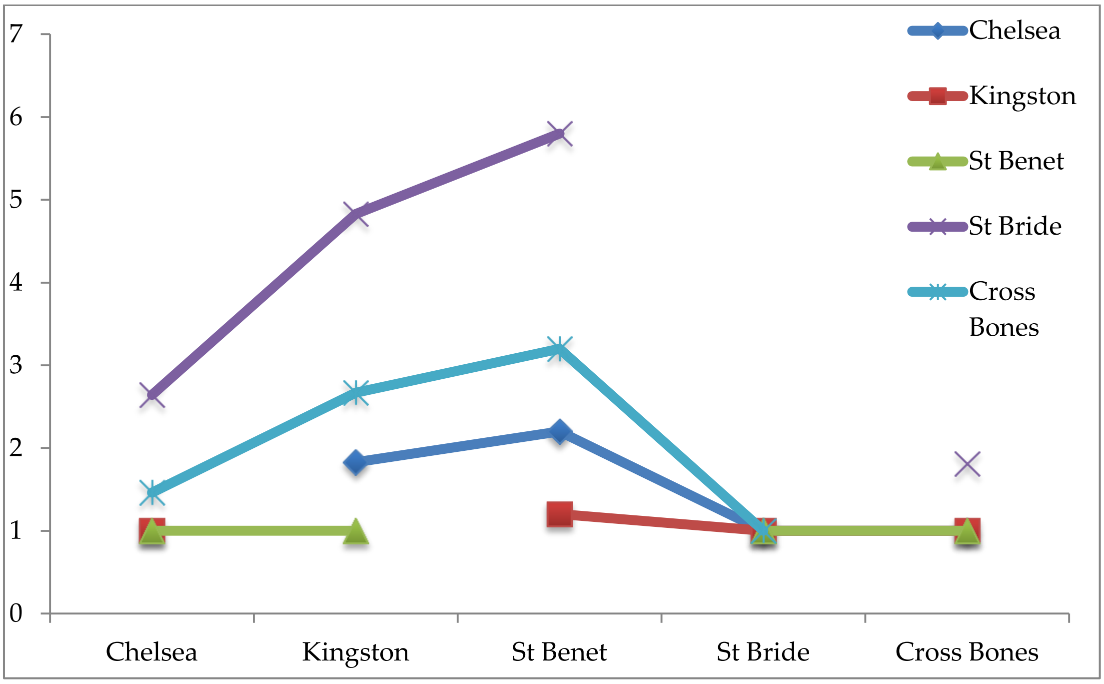


Figure 5.4 - The odds ratios corresponding to fractures located on the torso for the pair-wise comparisons of each collection.

5.1.3.3 Upper limbs

Similarly, all the collections had a standard fracture ratio for the upper limbs; as a result, comparisons were also possible for every pair. This anatomical area sees that Kingston is always more likely to have individuals with a fracture located on the upper limbs than any other collection (Figure 5.5). The highest ratio reveals that the individuals from Kingston are 4.5 times more likely than those from St Benet to have a fracture located on the upper limbs. On the other hand, the lowest ratio shows that it is only 1.2 times more likely that the individuals from Chelsea will have a fracture at this location as opposed to those from Cross Bones. The ratios for every pair-wise comparison can also be found in section 4.1.3.2 of Appendix 4.

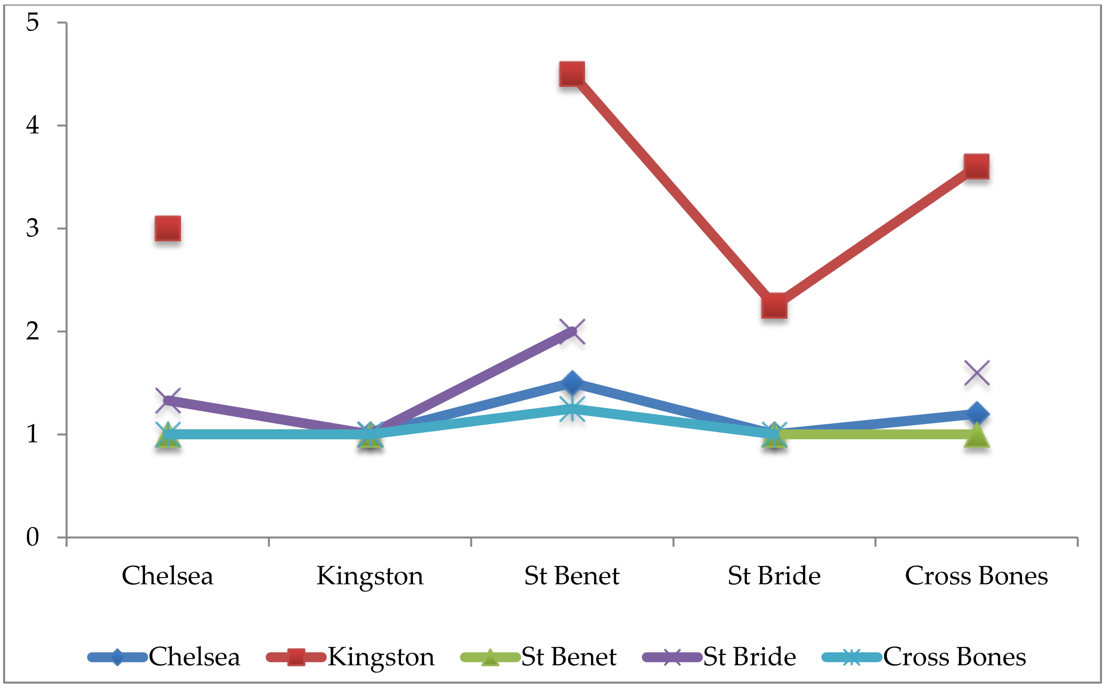


Figure 5.5 - The odds ratios for fractures of the upper limbs for pair-wise comparisons between each collection.

5.1.3.4 Hands

Table 5.4 displays the ratios for the fractures located on the hands. The standard fracture ratio for Kingston equals zero and makes any comparison featuring that collection invalid and is indicated by "n/a" in the table. In this case, the individuals from St Bride are three times more likely to have had a fracture located on the hands than the individuals from St Benet, which is the highest ratio for this anatomical area. The lowest ratio reveals that Chelsea is 1.33 times more likely to have individuals with fractures located on the hand bones than the Cross Bones burial ground.

Table 5.4 - The odds ratios for fractures of the hands for pair-wise comparisons between each collection.

	Odds Ratios	Compared with:
Chelsea	n/a	Kingston
Chelsea	2 : 1	St Benet
Chelsea	1 : 1.5	St Bride
Chelsea	1.33 : 1	Cross Bones
Kingston	n/a	St Benet
Kingston	n/a	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 3	St Bride
St Benet	1 : 1.5	Cross Bones
St Bride	2 : 1	Cross Bones

5.1.3.5 Lower limbs

All collections exhibit fractures on the lower limbs; therefore, comparisons are possible for each burial ground combination (Table 5.5). There are two instances in this table where a pair-wise comparison states that the individuals from one collection will have the same odds as another of suffering a fracture located on the lower limbs. As such, neither the individuals from Chelsea nor Cross Bones are more likely to exhibit this type of fracture than the other. The same is found when observing the comparison between Kingston and St Benet.

Table 5.5 reveals that St Bride is 2.4 times more likely to have an individual with a fracture at this location than the individuals from both Kingston and St Benet, which is the highest ratio. Mirroring the situation seen with the highest ratio, the lowest ratio also involves more than two collections. As a results, individuals from both Chelsea and Cross Bones are 1.4 times more likely to have had suffered a fracture on the bones of the lower limbs than if they have been exhumed from either the Kingston or the St Benet burial grounds.

Table 5.5 - The odds ratios for fractures of the lower limbs for pair-wise comparisons between each collection.

	Odds Ratios	Compared with:
Chelsea	1.4 : 1	Kingston
Chelsea	1.4 : 1	St Benet
Chelsea	1 : 1.71	St Bride
Chelsea	1	Cross Bones
Kingston	1	St Benet
Kingston	1 : 2.4	St Bride
Kingston	1 : 1.4	Cross Bones
St Benet	1 : 2.4	St Bride
St Benet	1 : 1.4	Cross Bones
St Bride	1.71 : 1	Cross Bones

5.1.3.6 Feet

Table 5.6 gives the ratios regarding the fractures located on the bones of the feet. A similar situation seen in the fractures on the lower limbs (Table 5.5) is also revealed for this anatomical area. The collections from Chelsea, St Bride and Cross Bones all have the same odds of having an individual who suffered a fracture on their feet during their lifetime; none is more likely than the other. The highest ratio indicates that Chelsea, St Bride and Cross Bones are all five times more likely to have an individual with a fracture at this location than St Benet. The lowest ratio finds that the same three collections are also 1.67 times more likely than Kingston to have an individual with a fracture on the feet.

Table 5.6 - The odds ratios for fractures of the feet for pair-wise comparisons between each collection.

	Odds Ratios	Compared with:
Chelsea	1.67 : 1	Kingston
Chelsea	5 : 1	St Benet
Chelsea	1	St Bride
Chelsea	1	Cross Bones
Kingston	3 : 1	St Benet
Kingston	1 : 1.67	St Bride
Kingston	1 : 1.67	Cross Bones
St Benet	1 : 5	St Bride
St Benet	1 : 5	Cross Bones
St Bride	1	Cross Bones

5.2 Males

5.2.1 Prevalence rates

The calculations found in section 5.1.1 were re-calibrated in order to demonstrate the prevalence rates found within the male population of the collective sample. The torso (n = 129) is the anatomical area with the highest number of males exhibiting a fracture while males with fractures on the feet (n = 26) have the lowest number (Table 5.7). This table includes the number of affected males from Bowling Green Lane since the data is not yet divided according to the individual collections. That information will be found in Table 5.8.

Table 5.7 - The number of males with a fracture for each anatomical area, including the males from Bowling Green Lane.

Bone	Males with a fracture
Skull	55
Torso	129
Upper	49
Hands	33
Lower	57
Feet	26

Once again, two crude prevalence rates were calculated based on the total male sample (n = 719) which includes the number of male who do not exhibit a fracture, and based on the total number of males with a fracture (n = 241). The highest crude prevalence rates are both found within the torso with 17.94% and 53.53%, respectively. Similarly to the results found in Figure 5.1, more than 50% of the individuals, in this case the male skeletons, with a fracture have a bony lesion located on the torso. The lowest ratios, 3.62% for the total male sample and 10.79% for the sample of males with a fracture, are both associated with fractures found on the feet (Figure 5.6).

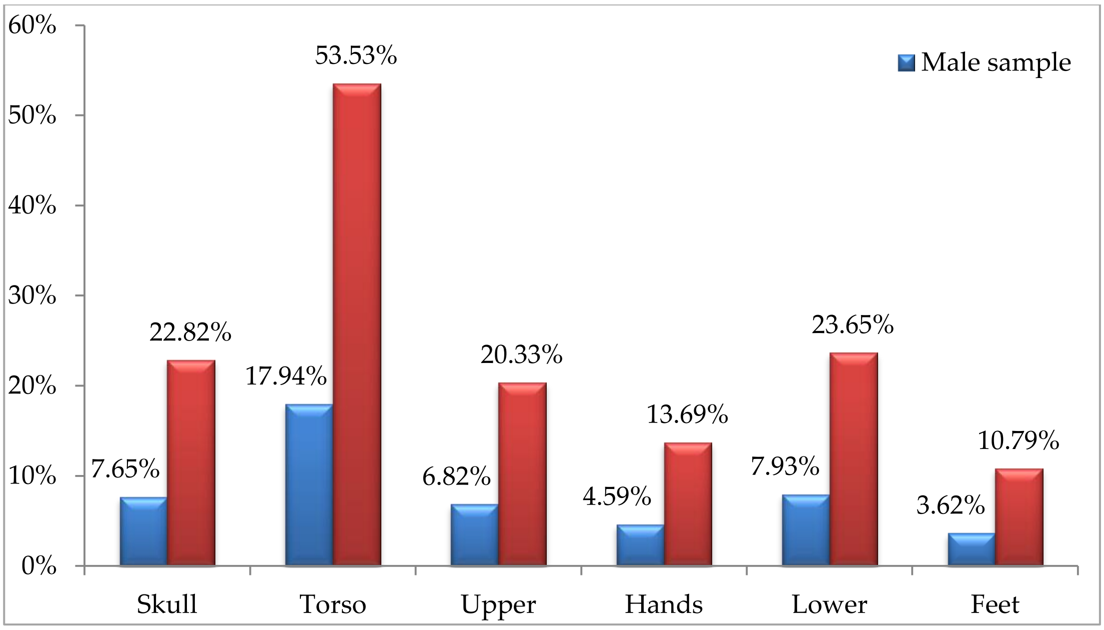


Figure 5.6 - The crude prevalence rates for the total male sample (n = 719) and the sample of males with a fracture (n = 241).

Table 5.8 represents the same information as above while being divvied according to each individual collection.

Table 5.8 - The number of males with a fracture (N.F), the number of males with a bone present in each anatomical area, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	Males with bone present	True prevalence rate
Chelsea (n = 90)				
Skull	5	5.56%	65	7.69%
Torso	9	10%	88	10.23%
Upper	5	5.56%	81	6.17%
Hands	4	4.44%	75	5.33%
Lower	7	7.78%	83	8.43%
Feet	5	5.56%	61	8.2%
Kingston (n = 23)				
Skull	0	0%	22	0%
Torso	2	8.7%	20	10%
Upper	2	8.7%	21	9.52%
Hands	0	0%	16	0%
Lower	1	4.35%	22	4.55%
Feet	1	4.35%	21	4.76%
Bowling Green Lane (n = 292)				
Skull	20	6.85%	n/a	n/a
Torso	54	18.49%	n/a	n/a
Upper	24	8.22%	n/a	n/a
Hands	11	3.77%	n/a	n/a
Lower	19	6.51%	n/a	n/a
Feet	9	3.08%	n/a	n/a
St Benet (n = 83)				
Skull	2	2.41%	61	3.28%
Torso	5	6.02%	78	6.41%
Upper	2	2.41%	78	2.56%
Hands	3	3.61%	74	4.05%
Lower	4	4.82%	77	5.2%
Feet	1	1.2%	64	1.56%
St Bride (n = 210)				
Skull	26	12.38%	176	15.15%
Torso	54	25.71%	202	26.73%
Upper	13	6.19%	189	6.88%
Hands	14	6.67%	167	8.38%
Lower	25	11.91%	180	13.89%
Feet	8	3.81%	122	6.56%

Table 5.8 cont. - The number of males with a fracture (N.F), the number of males with a bone present in each anatomical area, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	**N.F**	**Crude prevalence rate**	**Males with bone present**	**True prevalence rate**
Cross Bones (n = 21)				
Skull	2	9.52%	19	10.53%
Torso	4	19.05%	21	19.05%
Upper	1	4.76%	21	4.76%
Hands	1	4.76%	19	5.26%
Lower	1	4.76%	21	4.76%
Feet	2	9.52%	21	9.52%

The highest true fracture prevalence rate is seen in the torso for every collection. Figures 5.7 and 5.8 depict the true prevalence rates for each anatomical area according to each skeletal collection with the exception of Bowling Green Lane. In order to maintain fewer categories in Figure 5.7, the true rates where rounded to the closest number. Figure 5.8 presents the comparison of the collections' rates according to each anatomical area. Graphs for each individual skeletal collection depicting the crude and true rates according to each anatomical area are presented in Appendix 4 (section 4.2.1).

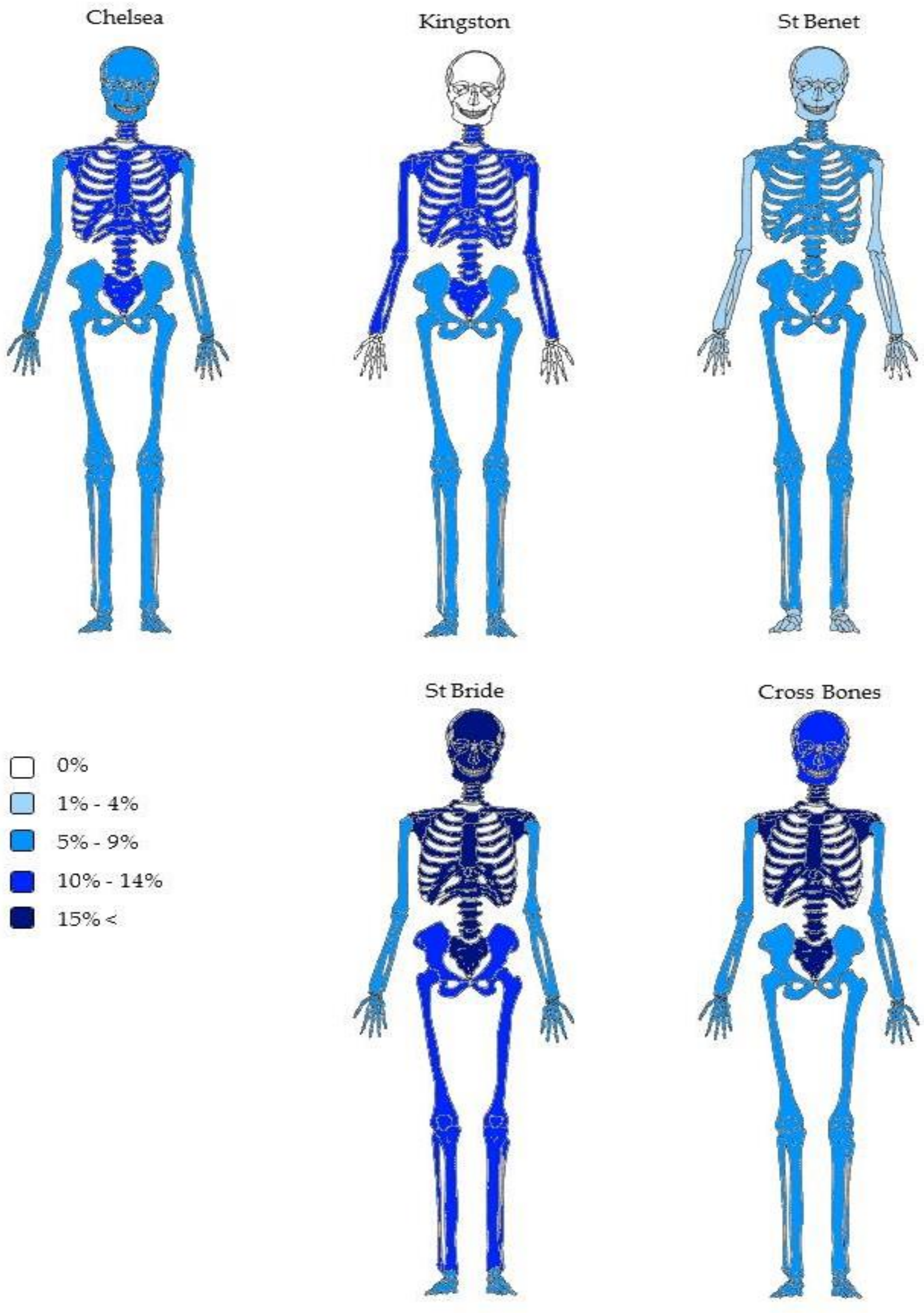


Figure 5.7 - The true fracture prevalence rates for each anatomical area according to the males in each skeletal collection which the exception of Bowling Green Lane.

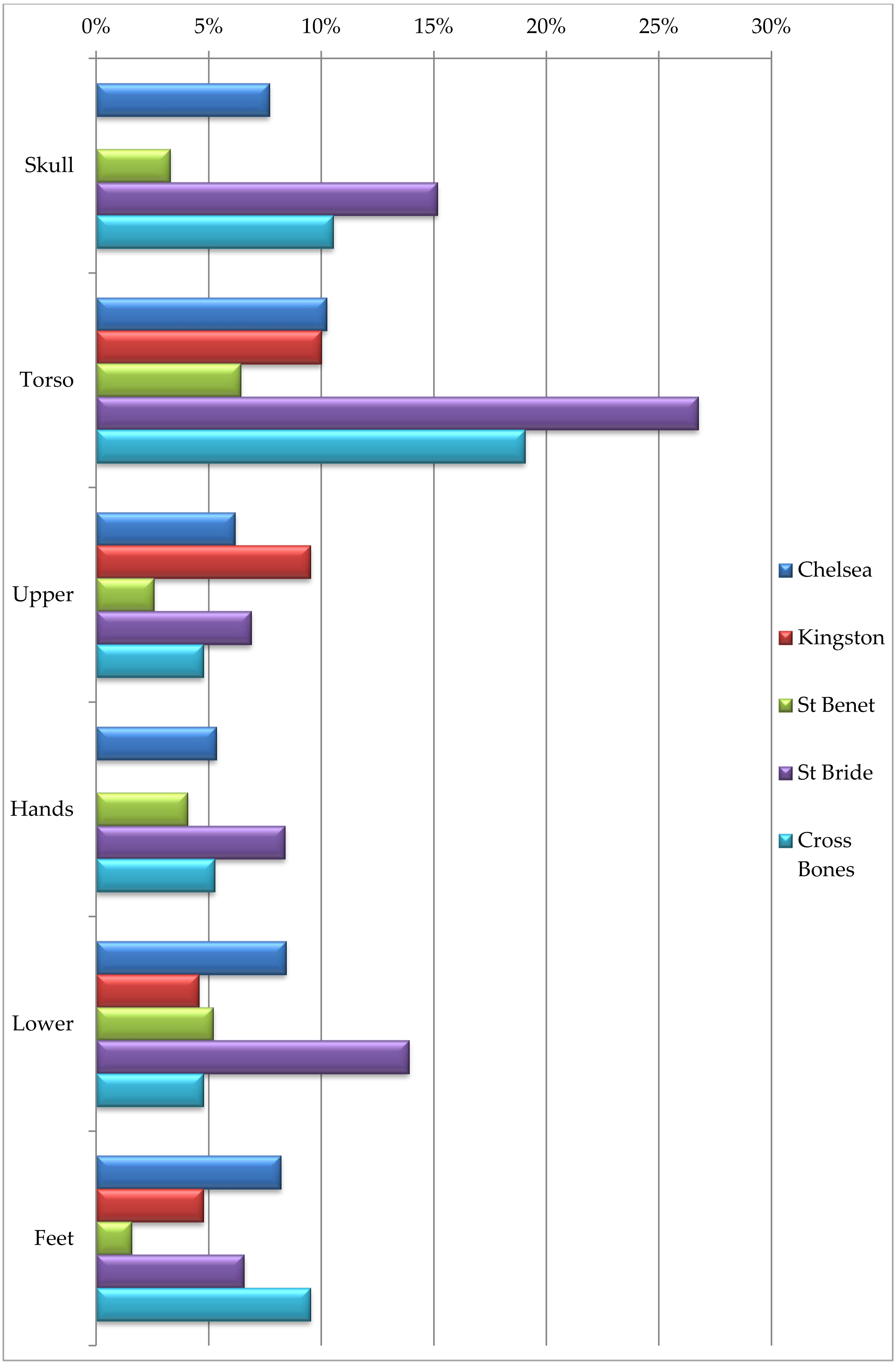


Figure 5.8 - The true prevalence rates for each anatomical area in each collection, with the exception of Bowling Green Lane, for the male sample.

5.2.2 Chi-squared test results

The number of males with a fracture, as well as the number of males without a fracture, who had a bone present in the anatomical area of interest, were entered into a chi-squared test and consequently compared statistically. All the anatomical areas were included in the test as there is at least one affected male when observing the various anatomical areas. It was found that there is a difference in the prevalence rates seen between the collections when all the anatomical areas were included in the test ($\chi^2 = 39.018$, df = 4, $p < 0.001$).

Since the test was layered according to each anatomical area, it is possible to determine if there is a difference between the collections when observing each anatomical location separately. However, due to the small expected count in certain anatomical areas, such as Kingston having zero fractures located on the hands for example, it is only possible to present the results from three anatomical areas: the skull, the torso and the lower limbs (Appendix 4, section 4.2.3). In each case, these three anatomical areas had a maximum of 20% of their expected counts with a value lower than five and the minimum expected count were all larger than one. The results for all three locations were statistically significant and the statistical values are as follows: the skull ($\chi^2 = 10.152$, df = 4, $p = 0.001$), the torso ($\chi^2 = 21.929$, df = 4, $p < 0.001$), and the lower limbs ($\chi^2 = 6.638$, df = 4, $p = 0.012$).

5.2.3 Standardised rate ratios

The standardised rate ratios (section 3.5.3.2 of Chapter 3) were calculated for every anatomical site seen within the male population. Since the collective sample was divided according to sex to observe the fracture prevalence rates in the male population, age will be the standardising variable throughout this section.

5.2.3.1 Skull

Table 5.9 presents the ratios found for the fractures located on the skull which yielded statistically significant results. Kingston's standard fracture ratio is zero and all comparisons featuring that collection will be invalid and is identified by "n/a" in the table. The highest ratio is between St Benet and St Bride where the latter is 4.35 times more likely to have this type of fracture than the former burial ground. The lowest ratio is between the males from Chelsea and Cross Bones where they are only 1.1 times more likely to have a fracture located on the skull if they came from the Chelsea burial ground.

Table 5.9 - The standardised rate ratios (SRR) for fractures located on the skull for pair-wise comparisons between the males of each collection.

	SRR	**Compared with:**
Chelsea	n/a	Kingston
Chelsea	2.98 : 1	St Benet
Chelsea	1 : 1.46	St Bride
Chelsea	1.1 : 1	Cross Bones
Kingston	n/a	St Benet
Kingston	n/a	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 4.35	St Bride
St Benet	1 : 2.72	Cross Bones
St Bride	1.6 : 1	Cross Bones

5.2.3.2 Torso

Figure 5.9 displays the results for the fractures found on the torso. This anatomical area also presented a statistical significance in the different prevalence rates seen between the collections. Every collection provided a standard fracture ratio and as such, comparisons were possible between the males from every skeletal collection. St Bride is 2.93 times more likely to have a fracture on this anatomical site than St Benet; accordingly, the highest ratio for fractures in this anatomical area. The lowest ratio states that the males from

Kingston are only 1.1 times more likely to have a fracture on the torso than if they had been exhumed from the St Benet burial ground. The ratios for every pair-wise comparison can also be found in section 4.2.4.1 of Appendix 4.

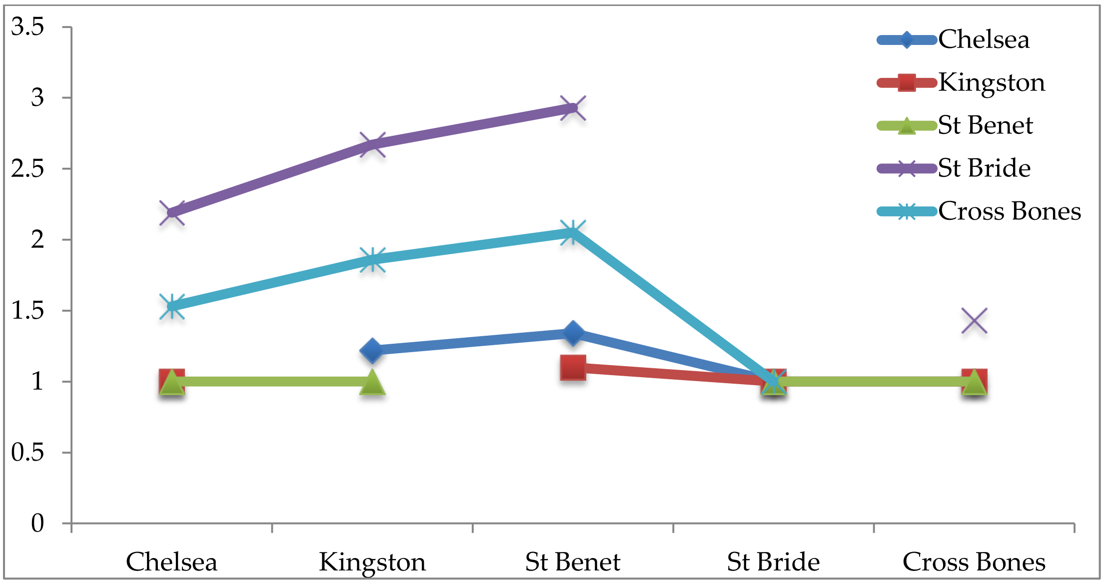


Figure 5.9 - The standardised rate ratios (SRR) for fractures located on the torso for pair-wise comparisons between the males of each collection.

5.2.3.3 Upper limbs

A standard fracture ratio was calculable for the fractures located on the upper limbs in every collection and as a result, comparisons were possible between all skeletal collections (Table 5.10). In this case, Kingston is always more likely than any other collection to have a male with a fracture on the upper limbs. The highest ratio is between the males from Kingston and Cross Bones where the former site is 1.74 times more likely to have fractures at this site than those from the later. This highest observable ratio for this particular anatomical location does not present a considerable difference. The lowest ratio is found between the males from St Benet and St Bride where St Benet is only 1.01 times more likely to have a male with a fracture on the upper limbs. These comparisons are the first occurrence in this chapter where St Benet is more likely than St Bride to have a fracture of any kind. Furthermore, the individuals from Cross Bones are now the collection where the males are always the least likely to have a fracture located on the upper limbs.

Table 5.10 - The standardised rate ratios (SRR) for fractures located on the upper limbs for pair-wise comparisons between the males of each collection.

	SRR	Compared with:
Chelsea	1 : 1.24	Kingston
Chelsea	1.05 : 1	St Benet
Chelsea	1.06 : 1	St Bride
Chelsea	1.41 : 1	Cross Bones
Kingston	1.3 : 1	St Benet
Kingston	1.31 : 1	St Bride
Kingston	1.74 : 1	Cross Bones
St Benet	1.01 : 1	St Bride
St Benet	1.34 : 1	Cross Bones
St Bride	1.32 : 1	Cross Bones

5.2.3.4 Hands

Table 5.11 presents the ratios found for the fractures located on the hands of the male population in the collective sample. Kingston's standard fracture ratio is zero and all comparisons featuring this collection will be invalid and is represented by "n/a" in the table. The highest ratio is between St Benet and St Bride where the males from the latter are 1.91 times more likely to have this type of fracture than those from the former burial ground. The lowest ratio is found in two comparisons. The males from Chelsea are 1.16 times more likely than those from Cross Bones to have a fracture located on the hands, while the males from Cross Bones are also 1.16 times more likely to have a fracture on the hands than those from St Benet.

Table 5.11 - The standardised rate ratios (SRR) for fractures located on the hands for pair-wise comparisons between the males of each collection.

	SRR	Compared with:
Chelsea	n/a	Kingston
Chelsea	1.34 : 1	St Benet
Chelsea	1 : 1.42	St Bride
Chelsea	1.16 : 1	Cross Bones
Kingston	n/a	St Benet
Kingston	n/a	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 1.91	St Bride
St Benet	1 : 1.16	Cross Bones
St Bride	1.65 : 1	Cross Bones

5.2.3.5 Lower limbs

Table 5.12 displays the ratios found between the collections when comparing the fractures on the lower limbs which yielded statistically significant results. In this case, rather than St Benet being the collection that is the least likely of all to have a fracture at this location, as has been seen numerous times in previous comparisons found in the previous and current chapters, the collection that is always the least likely to have individuals with a fracture located on the lower limbs is Cross Bones. The highest ratio reveals that the males from St Bride are 2.79 times more likely than those from Cross Bones to have a fracture on the lower limbs. The lowest ratio is found between St Benet and Kingston where the former is only 1.06 times more likely to have a male with a fracture on the lower limbs than those from the latter.

Table 5.12 - The standardised rate ratios (SRR) for fractures on the lower limbs for pair-wise comparisons between the males of each collection.

	SRR	Compared with:
Chelsea	1.86 : 1	Kingston
Chelsea	1.76 : 1	St Benet
Chelsea	1 : 1.2	St Bride
Chelsea	2.33 : 1	Cross Bones
Kingston	1 : 1.06	St Benet
Kingston	1 : 2.23	St Bride
Kingston	1.25 : 1	Cross Bones
St Benet	1 : 2.11	St Bride
St Benet	1.32 : 1	Cross Bones
St Bride	2.79 : 1	Cross Bones

5.2.3.6 Feet

The fractures located on the feet yielded a standard fracture ratio for all the collections; hence, the standardised rate ratios were calculable for every collection (Figure 5.10). In this case, the males from Chelsea are only 1.06 times more likely to have a fracture on their feet than those from St Bride. In the majority of cases seen above as well as in the previous Results chapter, St Bride has been more likely than any other collection to exhibit a fracture, not least likely. Additionally, this is the lowest ratio in the table. The highest ratio indicates that the men from Cross Bones are 6.03 times more likely to have suffered a fracture on their feet over the course of the their lifetime than if they had been exhumed from the St Benet burial ground. The ratios for every pair-wise comparison can also be found in section 4.2.4.2 of Appendix 4.

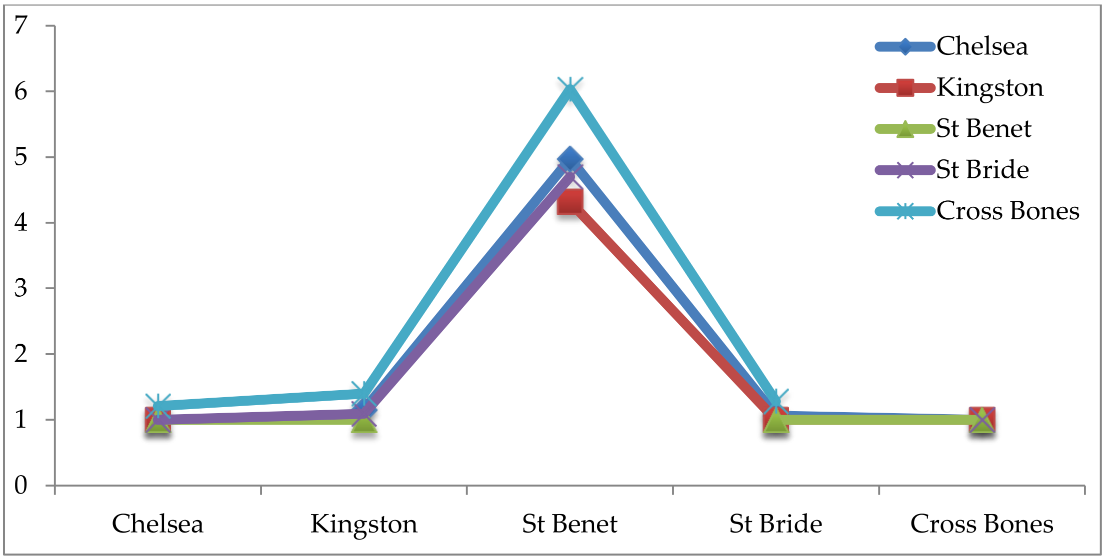


Figure 5.10 - The standardised rate ratios (SRR) for fractures on the feet for pair-wise comparisons between the males of each collection.

5.3 Females

5.3.1 Prevalence rates

The calculations found in section 5.1 were re-calibrated in order to demonstrate the prevalence rates found within the female population of the sample. The torso (n = 49) has the highest number of affected females within a particular anatomical area while females with fractures on the feet (n = 2) have the lowest number (Table 5.13).

Table 5.13 - The number of females with a fracture for each anatomical area, including the females from Bowling Green Lane.

Bone	Females with a fracture
Skull	15
Torso	49
Upper	24
Hands	3
Lower	16
Feet	2

The highest crude prevalence rates are both found within the torso with 12.07% and 55.68%, depending on whether the total number of females (n = 406) is being observed or the number of females with a fracture (n = 88), respectively. The lowest crude rates, 0.49% and 2.27%, respectively, are both associated with the feet (Figure 5.11).

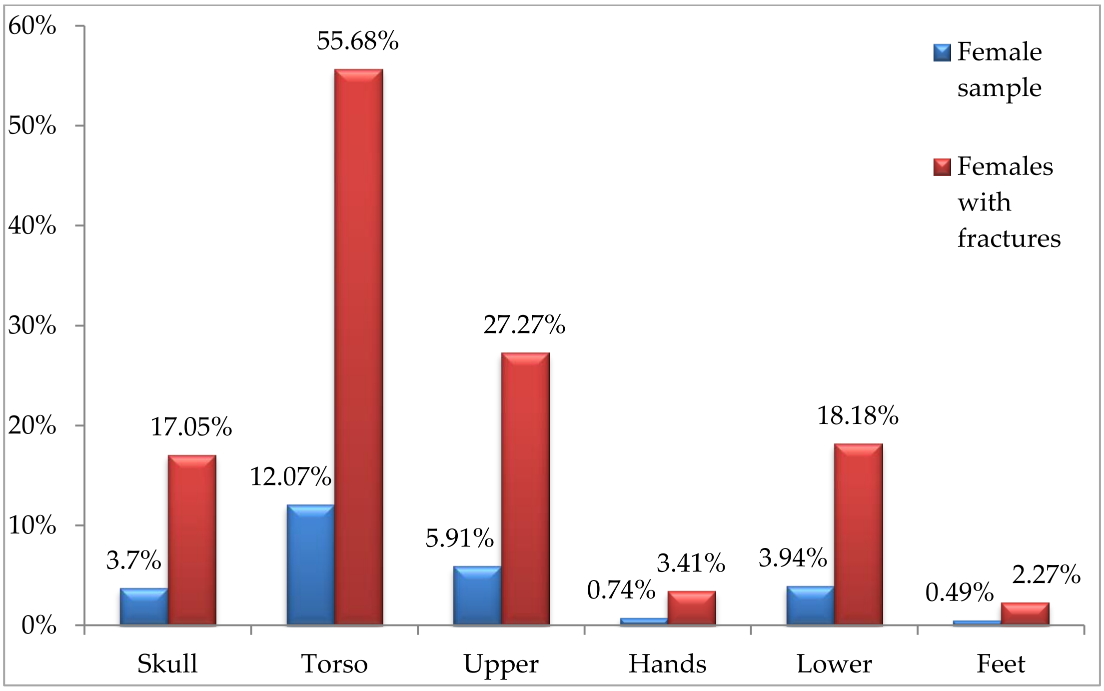


Figure 5.11 - The crude prevalence rates for the female sample (n = 406) and the sample of females with a fracture (n = 88).

Table 5.14 represents the same information as above while being demarcated according to the individual collections.

Table 5.14 - The number of females with a fracture (N.F), the number of females with a bone present in each anatomical area, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	Females with bone present	True prevalence rate
Chelsea (n = 55)				
Skull	1	1.82%	35	2.86%
Torso	4	7.27%	53	7.55%
Upper	3	5.46%	53	5.66%
Hands	1	1.82%	48	2.08%
Lower	4	7.27%	53	7.55%
Feet	0	0%	31	0%

Table 5.14 cont. - The number of females with a fracture (N.F), the number of females with a bone present in each anatomical area, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	**N.F**	**Crude prevalence rate**	**Females with bone present**	**True prevalence rate**
Kingston (n = 17)				
Skull	0	0%	16	0%
Torso	0	0%	16	0%
Upper	3	17.65%	16	18.75%
Hands	0	0%	13	0%
Lower	1	5.88%	17	5.88%
Feet	0	0%	14	0%
Bowling Green Lane (n = 159)				
Skull	5	3.15%	n/a	n/a
Torso	23	14.47%	n/a	n/a
Upper	7	4.4%	n/a	n/a
Hands	0	0%	n/a	n/a
Lower	5	3.15%	n/a	n/a
Feet	2	1.26%	n/a	n/a
St Benet (n = 39)				
Skull	0	0%	31	0%
Torso	0	0%	38	0%
Upper	1	2.56%	39	2.56%
Hands	0	0%	37	0%
Lower	2	5.13%	39	5.13%
Feet	0	0%	32	0%
St Bride (n = 114)				
Skull	9	7.89%	94	9.58%
Torso	21	18.42%	112	18.75%
Upper	9	7.89%	111	8.12%
Hands	2	1.75%	107	1.87%
Lower	3	2.63%	109	2.75%
Feet	0	0%	67	0%
Cross Bones (n = 22)				
Skull	0	0%	22	0%
Torso	1	4.55%	22	4.55%
Upper	1	4.55%	22	4.55%
Hands	0	0%	18	0%
Lower	1	4.55%	22	4.55%
Feet	0	0%	18	0%

Unlike the males, the highest fracture prevalence rates are not found in the same anatomical area in every collection. Chelsea's highest rates are 7.27% for the crude rate and 7.55% for the true rate and these rates apply to both the fractures seen on the torso as well as the fractures on the lower limbs. The highest rates for the Kingston burial ground are seen in the upper limbs (17.65% for the crude rate and 18.75% for the true rate) while the torso has the highest crude rate (14.47%) for Bowling Green Lane. The females from Bowling Green Lane are the only collection to present any fractures on the feet. St Benet only has two anatomical areas that present fractures in the female sample: the upper (2.56%) and lower limbs (5.13%). Moreover, the true rates for the two anatomical areas, gathered from the females from St Benet, are identical to the aforementioned crude rates. Similarly to Bowling Green Lane, the highest prevalence rates for St Bride (18.42% for the crude rate and 18.75% for the true rate) are also found within the torso. Cross Bones has three locations which provide prevalence rates: the torso, the upper limbs and the lower limbs. The crude and true fracture prevalence rates are all identical (4.55%) for each anatomical area.

Figures 5.12 and 5.13 depict the true prevalence rates for each anatomical area according to each skeletal collection with the exception of Bowling Green Lane. In order to maintain fewer categories in Figure 5.12, the true rates where rounded to the closest number. Figure 5.13 groups together the true prevalence rates for each collection so that they may be better compared according to the individual anatomical areas. Graphs for each skeletal collection depicting the crude and true rates for each anatomical area are presented in Appendix 4 (section 4.2.2).

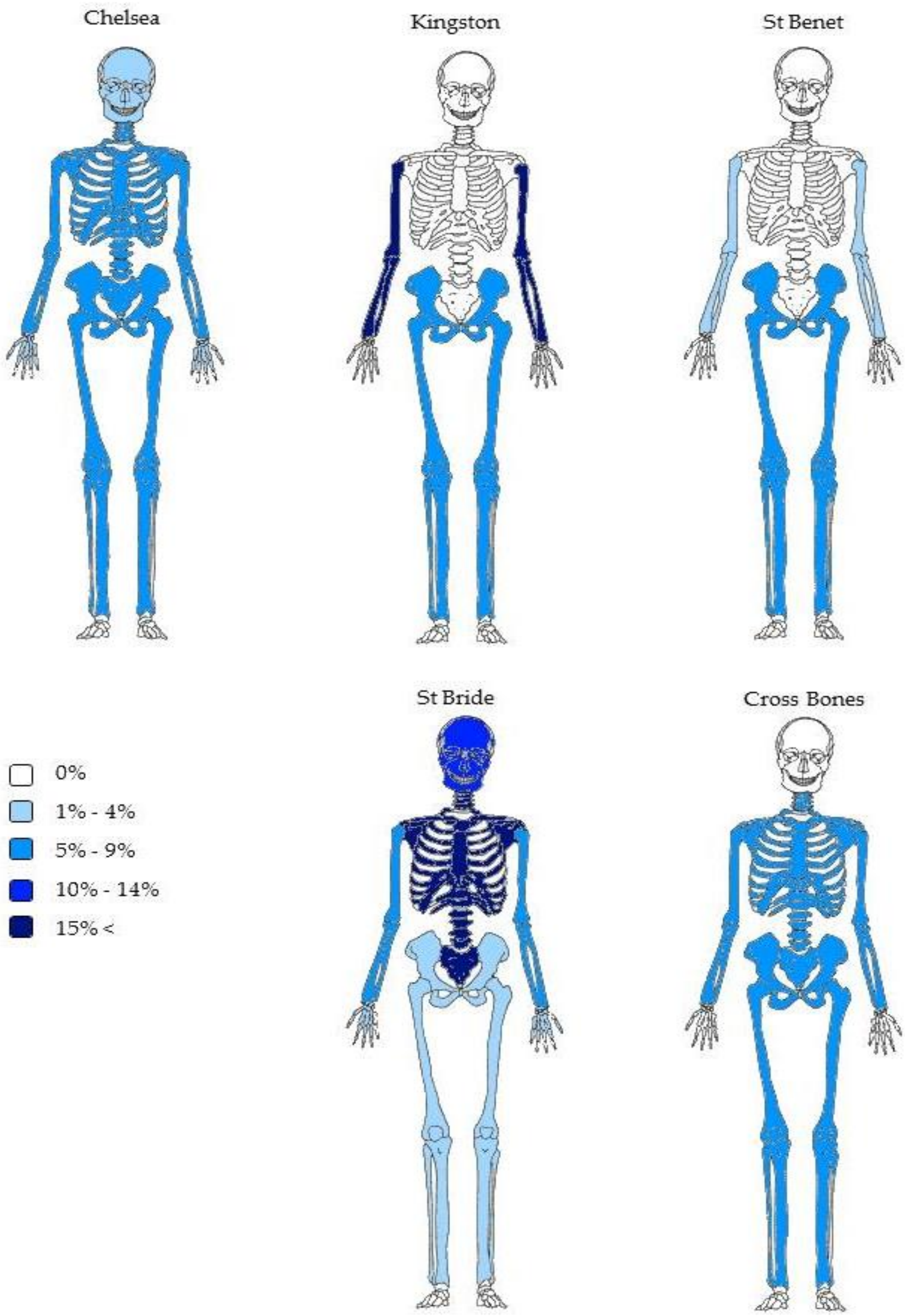


Figure 5.12 - The true fracture prevalence rates for each anatomical area according to the females in each skeletal collection which the exception of Bowling Green Lane.

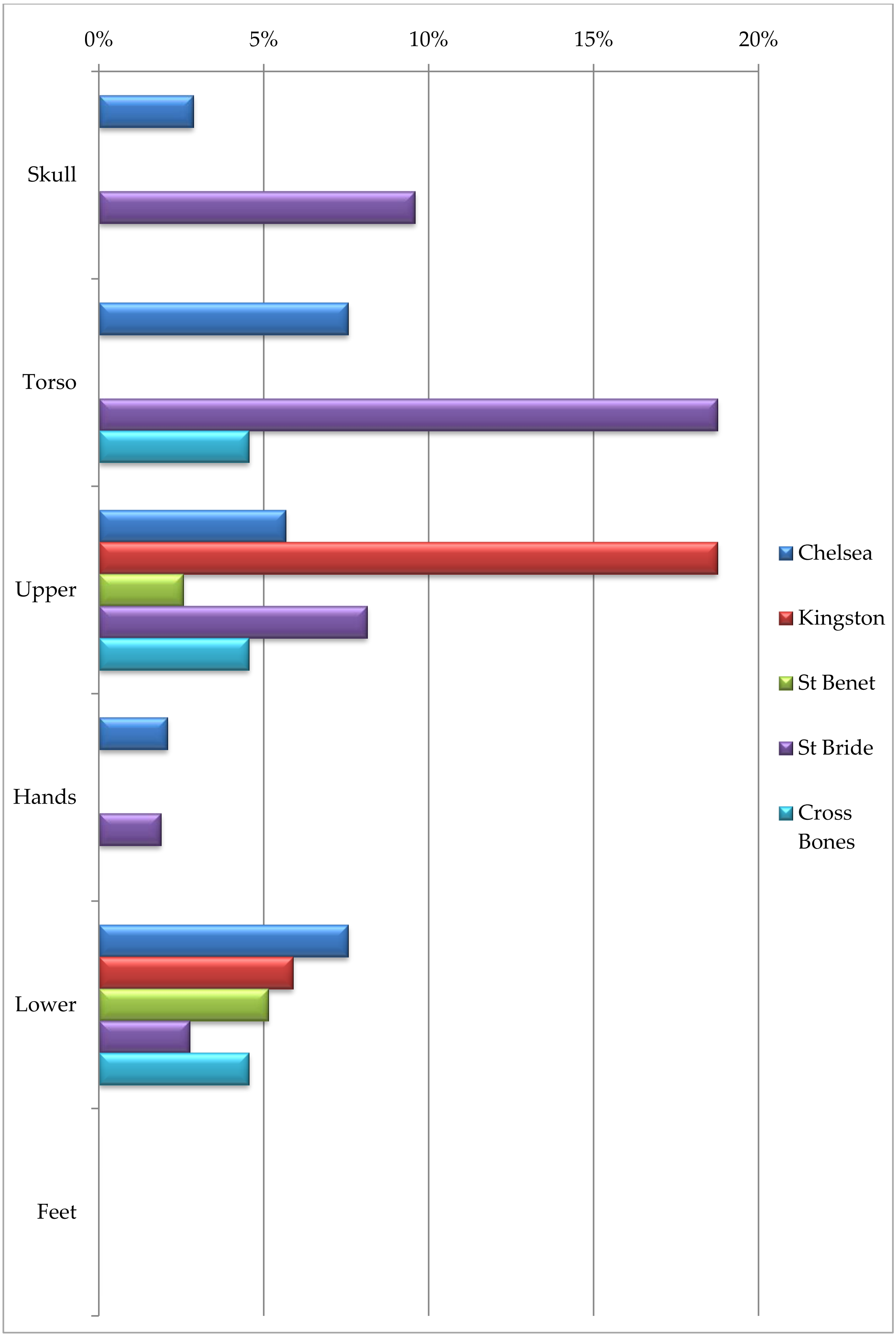


Figure 5.13 - The true prevalence rates for each anatomical area in each collection, which the exception of Bowling Green Lane, for the female sample.

5.3.2 Chi-squared test results

Using the same statistical test as in section 5.2.2, the chi-squared test results were observed for the females in the sample. For this sex, it was found that the differences seen between the collections in each anatomical areas were statistically significant ($\chi^2 = 14.204$, df = 4, $p < 0.001$) when observing the anatomical areas collectively. When looking at the chi-squared test output (Appendix 4, section 4.2.3), the lowest expected count is 4.57 and it is the only instance where it is lower than five. As a result, the chi-squared test result is valid.

However, this is not the case when reporting the results for the differences seen between the collections when the anatomical areas are observed separately. All six anatomical areas have 30% or more of their expected counts that are lower than 5, which will nullify any other statistical tests where each anatomical area is observed separately.

5.3.3 Standardised rate ratios

Since the sample was divided according to sex, age will be the standardising variable throughout this section when calculating the standardised rate ratios. Since none of the females have a fracture located on the feet, no comparisons were made for this specific anatomical area.

5.3.3.1 Skull

None of the comparisons between the collections were possible for the fractures located on the skull as only one collection, St Bride, had a standard fracture ratio. Evidently, a second standard fracture ratio is needed in order to calculate the standardised rate ratio between two collections.

5.3.3.2 Torso

Three collections were available for comparison pertaining to the fractures located on the torso. St Bride is 2.23 times more likely than Chelsea and 4.7 times more likely than Cross Bones to have a female with a fracture located in that area. Furthermore, Chelsea is 2.11 times more likely to have a female with a fracture on the torso than those from Cross Bones.

5.3.3.3 Upper limbs

A standard fracture ratio was calculable, for the fractures located on the upper limbs, in every collection and as a result, comparisons were possible between all skeletal collections (Figure 5.14). When Kingston was compared with every collection, it was always more likely that a fracture of the upper limbs happened to a female from this burial ground than any other. The highest ratio for this anatomical site is between Kingston and Cross Bones where the females from the former are 4.99 times more likely to have a fracture located on the upper limbs than if they had been exhumed from the latter.

Also, the females from St Benet are not always the least likely to have a fracture at this location which has been a recurring theme throughout this chapter as well as the previous Results chapter. This is seen in the comparison between St Benet and Cross Bones where the females from St Benet are 1.63 times more likely than those from Cross Bones to have suffered a fracture on the upper limbs. The lowest ratio also demonstrates this and indicates that the females from St Benet are 1.02 times more likely to have a fracture of the upper limbs than those from Chelsea. The ratios for every pair-wise comparison can also be found in section 4.2.5.1 of Appendix 4.

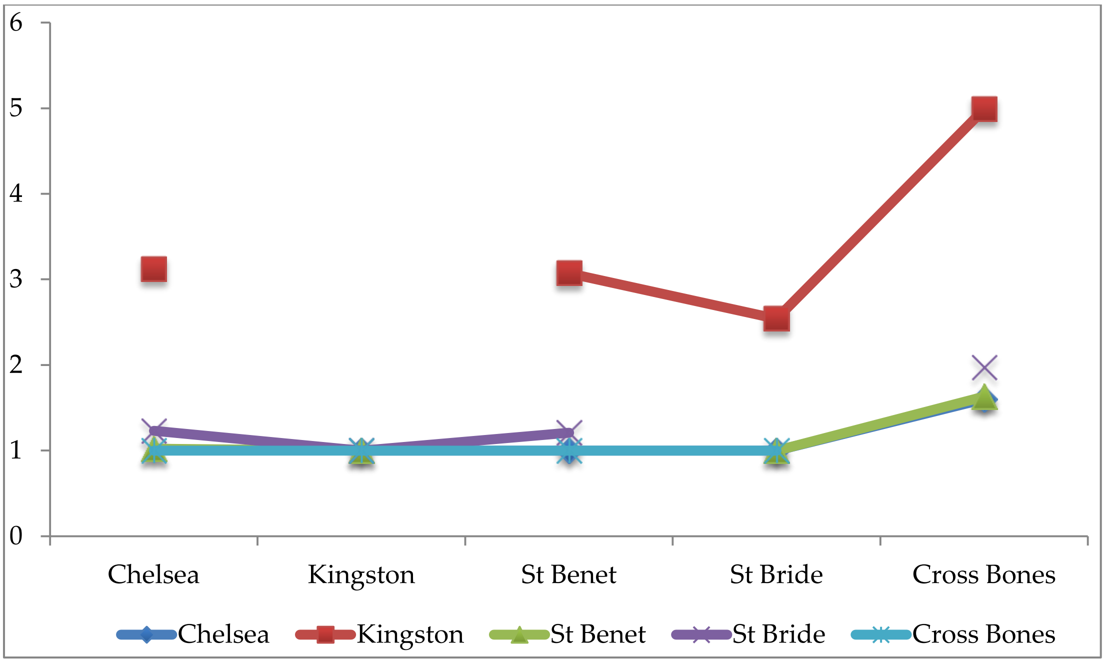


Figure 5.14 - The standardised rate ratios (SRR) for fractures located on the upper limbs for pair-wise comparisons between the females of each collection.

5.3.3.4 Hands

Only two collections were available for comparison for the fractures located on the hands when observing the females in the sample. The females from St Bride are only 1.19 times more likely to have fracture on the hand bones than the females from Chelsea. All other comparisons were not possible due to the other collections not having any females with fractures located on their hands.

5.3.3.5 Lower limbs

Table 5.15 displays the ratios found between the collections when comparing the fractures on the lower limbs. Kingston's standard fracture ratio was zero and as a result any comparison featuring that collection will not be possible and is indicated by "n/a" in the table. The results from this anatomical area are similar to what was seen with the upper limbs where the females from St Benet are not always the least likely to have this type of fracture when compared with the other collections.

The highest ratio is found between St Benet and St Bride where the females from the former are 2.55 times more likely to have a fracture on the lower limbs than those from St Bride. It has been a very rare occurrence so far in the current thesis when individuals from St Benet are more likely than those from St Bride to have suffered a fracture over the course of their lifetime. Habitually, the individuals from St Bride have a higher fracture prevalence rate than St Benet, which translates into being more likely to exhibit fractures than the latter burial ground. The lowest ratio shows that Chelsea is only 1.04 times more likely to have a female with a fracture at this location than Cross Bones.

Table 5.15 - The standardised rate ratios (SRR) for fractures on the lower limbs for pair-wise comparisons between the females of each collection.

	SRR	**Compared with:**
Chelsea	n/a	Kingston
Chelsea	1 : 1.94	St Benet
Chelsea	1.31 : 1	St Bride
Chelsea	1.04 : 1	Cross Bones
Kingston	n/a	St Benet
Kingston	n/a	St Bride
Kingston	n/a	Cross Bones
St Benet	2.55 : 1	St Bride
St Benet	2.02 : 1	Cross Bones
St Bride	1.26 : 1	Cross Bones

5.4 Comparison between the sexes

5.4.1 Prevalence rates

The true fracture prevalence rates for each anatomical area, according to each sex, are presented as a graph (Figure 5.15) in order to compare the sexes. The data was taken from Tables 5.7 for the males and 5.13 for the females and excludes the data from Bowling Green Lane. The males have higher rates in every anatomical location, with the exception of the upper limbs. The torso has the highest rate for both sexes while the lowest rates are seen in the feet for both the males and females.

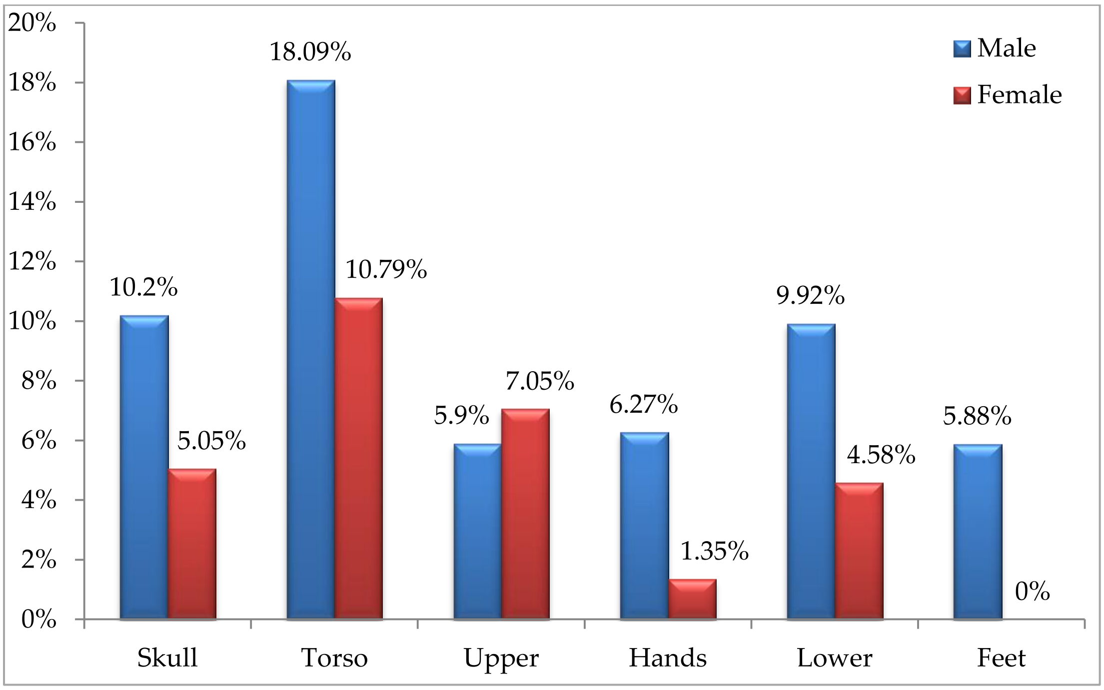


Figure 5.15 - The true prevalence rates for each anatomical area according to each sex.

Figure 5.16 presents the true prevalence rates for each sex when analysing each anatomical area in the individual skeletal collections.

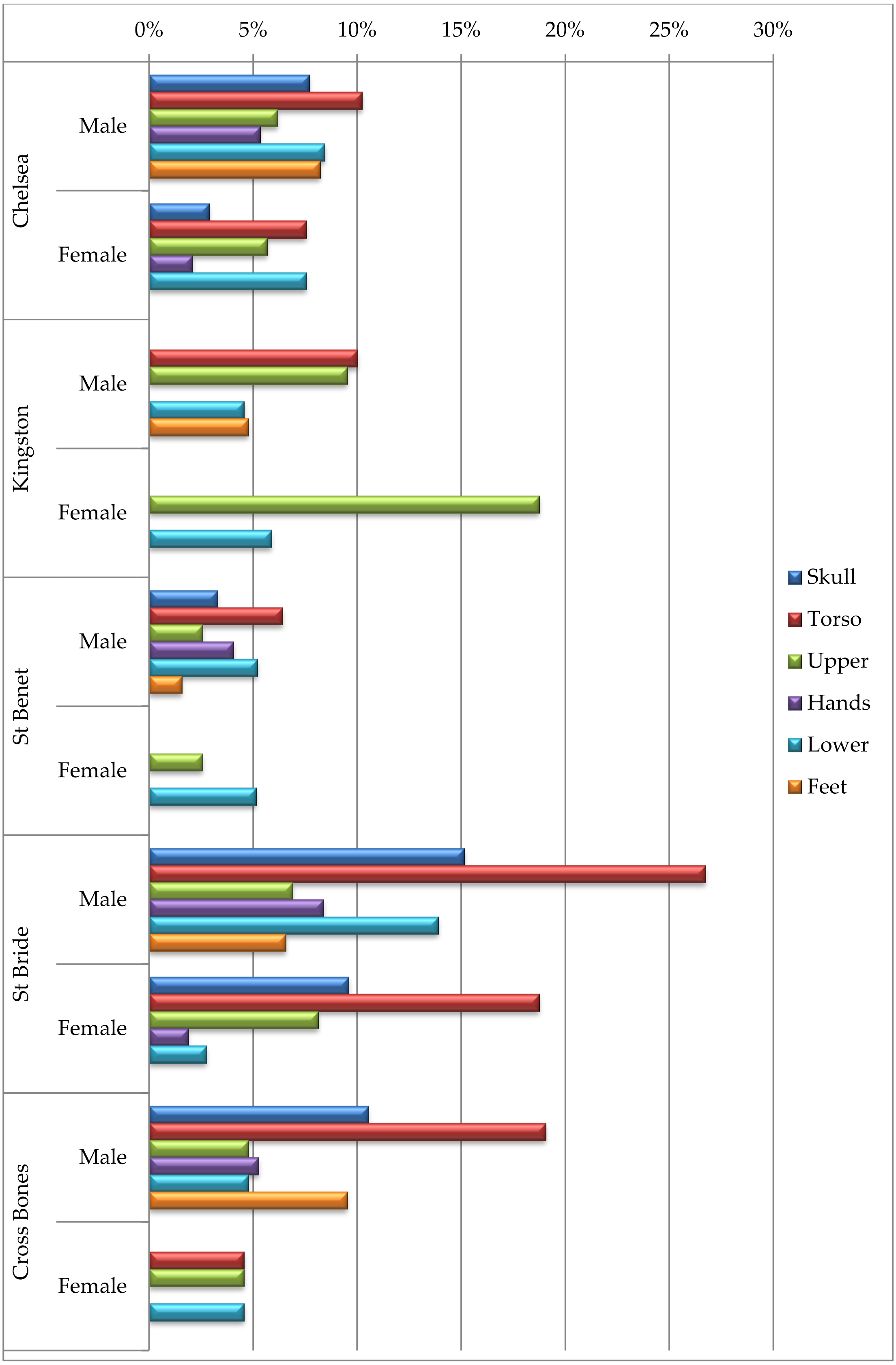


Figure 5.16 - The true prevalence rates for each anatomical area as well as for each sex in each collection.

5.4.2 Chi-squared test results

The chi-squared test which yielded the results presented in sections 5.2.2 and 5.3.2 also allows for the sexes to be compared (Appendix 4, section 4.2.3). The chi-squared test result indicated that the differences seen between the sexes, where the anatomical area are observed collectively and every collection is included, was statistically significant ($\chi^2 = 51.783$, df = 4, $p < 0.001$).

When observing the individual anatomical areas, the results of the comparison between the sexes, when all the collections are included, can be presented for the skull, the torso, the upper limbs and the lower limbs. All of these anatomical areas either have expected counts that are more than five, or no more than 20% of the expected counts had a value lower than five with a minimum value equalling one (Appendix 4, section 4.2.3). The results are as follows: the skull ($\chi^2 = 17.185$, df = 4, $p < 0.001$), the torso ($\chi^2 = 35.613$, df = 4, $p < 0.001$), the upper limbs ($\chi^2 = 6.752$, df = 4, $p = 0.006$) and the lower limbs ($\chi^2 = 3.397$, df = 4, $p = 0.063$). The only statistically insignificant result is found within the lower limbs.

5.4.3 Standardised rate ratios

The standardised rate ratios were calculated for every anatomical site seen within the male and female populations of the collective sample. Since the sample was divided according to sex, age will be the standardising variable when comparing the males with the females.

The males in the collective sample are 2.19 times more likely to exhibit a skull fracture than the females in the collective sample. The ratio is lower when calculated for the fractures on the torso; the males are 1.57 times more likely to have that type of fracture than the females. Fractures located on the upper limbs present a different outcome as the females are 1.29 times more likely than the males to have a fracture located on that particular area of the body. This ratio is also the lowest found between the sexes when observing the different anatomical areas. The above three ratios are all associated with statistically significant results.

The hand fractures have the highest ratio seen between the two sexes, where the males are 4.48 times more likely to have a hand fracture. The males are also more likely to have a fracture on the lower limbs, 1.95 times more so than the females in the collective sample. Since none of the females had any fractures on the feet, the standard fracture ratio was zero; as a result, the comparison with the males in the sample and the subsequent standardised rate ratio was not possible. The ratios are illustrated in Figure 5.17.

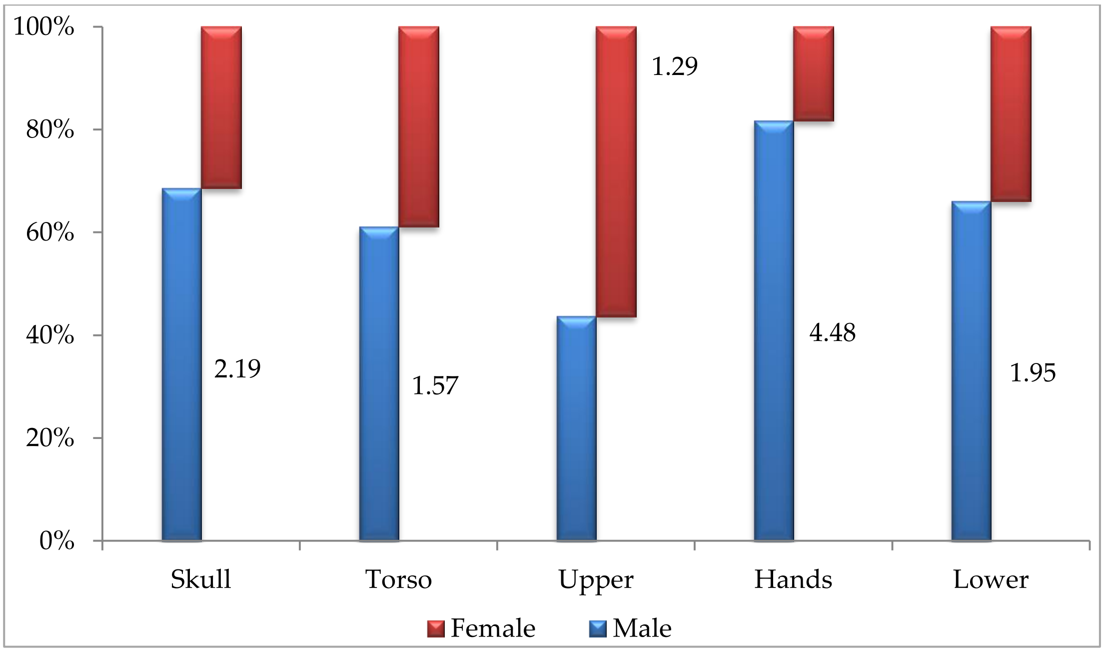


Figure 5.17 - The standardised rate ratios for each anatomical area, with the exception of the feet, when comparing the sexes.

5.5 Young Adults

In the following four sub-sections, the individuals from Bowling Green Lane were no included due to the unavailable information regarding the age at death of the individuals without a fracture. As a result, it was possible to use the information gathered from the remaining five skeletal collections and include the number of individuals with bones present for each anatomical area in every section focusing on the age categories.

5.5.1 Prevalence rates

The calculations found in section 5.1 were re-calibrated in order to demonstrate the fracture prevalence rates found within the young adults (YA) of the sample. Table 5.16 presents the number of YA within each anatomical area as well as the number of individuals with at least one bone present in each anatomical area for this particular age category. The torso has the highest number (n = 11) of YA with fractures in any particular area while the YA with skull fractures as well as those with fractures on the feet both have the lowest number (n = 4).

Table 5.16 - The number of YA with a fracture (N.F) for each anatomical area, as well as the number of YA with a bone present in each anatomical area.

Bone	N.F	YA with bone present
Skull	4	154
Torso	11	194
Upper	5	193
Hands	5	179
Lower	8	194
Feet	4	126

As with the male and female sample, two crude fracture prevalence rates were calculated (Figure 5.18). One is calculated from the total number of YA gathered from each collection (n = 198), with the exception of BGL; the other is focused on the overall number of YA with a fracture (n = 33). The highest crude rates seen in the YA population, 5.58% for the collective YA sample and 33.33% for the sample of YA with a fracture, are both found in the fractures on the torso. The fractures on the skull as well as those on the hands share the lowest rates which are 2.03% and 12.12% for the collective YA sample and the sample of YA with a fracture, respectively.

Additionally, the true rates were included which were calculated using the total number of YA with a bone present in each anatomical area (Table 5.16) in order to see the possible accuracy given by the crude rate calculated from the overall YA sample, regardless of whether or not an individual had suffered a fracture over the course of their lifetime.

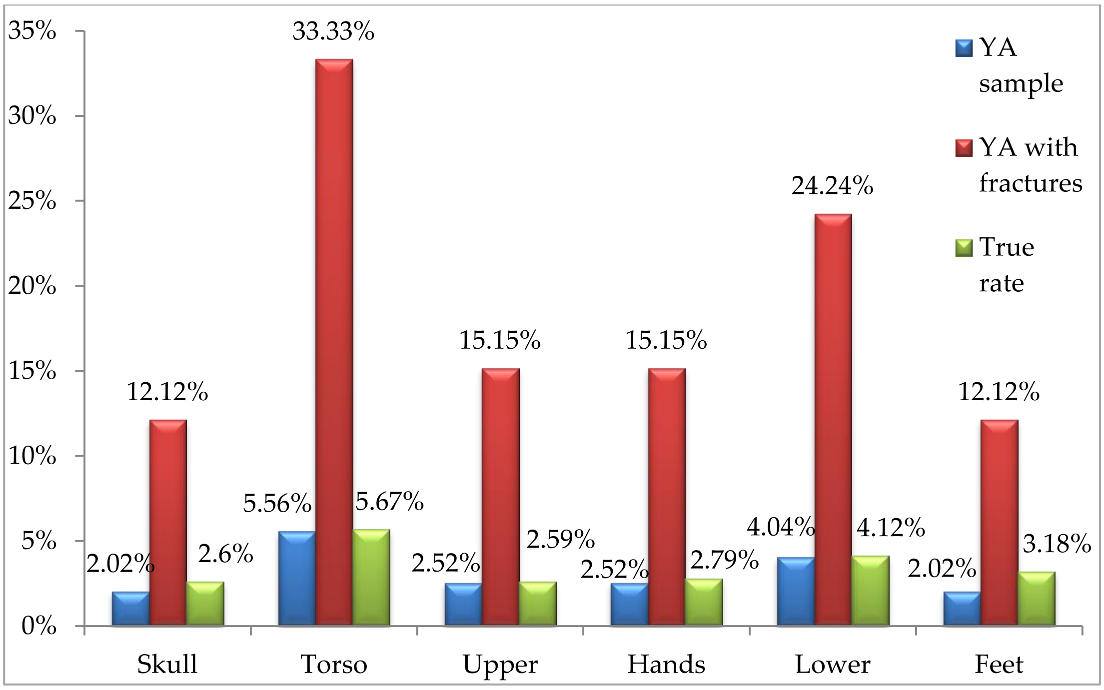


Figure 5.18 - The crude prevalence rates for the YA sample (n = 198), with the exception of Bowling Green Lane, as well as the sample of YA with a fracture (n = 33) and their associated true prevalence rates.

Table 5.17 represents the crude and true rates while being delineated by the individual collections.

Table 5.17 - The number of YA with a fracture (N.F), the number of YA with a bone present in each anatomical area, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	YA with bone present	True prevalence rate
Chelsea (n = 49)				
Skull	1	2.04%	36	2.78%
Torso	2	4.08%	47	4.26%
Upper	3	6.12%	48	6.25%
Hands	1	2.04%	44	2.27%
Lower	2	4.08%	48	4.17%
Feet	2	4.08%	33	6.06%
Kingston (n = 6)				
Skull	0	0%	6	0%
Torso	0	0%	6	0%
Upper	2	33.33%	6	33.33%
Hands	0	0%	5	0%
Lower	0	0%	6	0%
Feet	0	0%	4	0%
St Benet (n = 56)				
Skull	1	1.79%	41	2.44%
Torso	0	0%	55	0%
Upper	0	0%	55	0%
Hands	2	3.57%	51	3.92%
Lower	3	5.36%	53	5.66%
Feet	0	0%	41	0%
St Bride (n = 76)				
Skull	2	2.63%	60	3.33%
Torso	10	13.16%	75	13.33%
Upper	1	1.32%	73	1.37%
Hands	2	2.63%	70	2.86%
Lower	3	3.95%	76	3.95%
Feet	1	1.32%	38	2.63%
Cross Bones (n = 11)				
Skull	0	0%	11	0%
Torso	0	0%	11	0%
Upper	0	0%	11	0%
Hands	0	0%	10	0%
Lower	0	0%	10	0%
Feet	1	9.09%	10	10%

The highest true prevalence rate varies within the collections. Chelsea and Kingston see their highest true rates within the upper limbs, 6.38% and 33.33%, respectively. The lower limbs have the highest true rate (5.66%) for the YA from St Benet while the torso has a top true rate of 13.33% for St Bride. Finally, Cross Bones only has one anatomical site where the YA exhibit fractures and that is the feet, with a true rate of 10%.

Figures 5.19 and 5.20 depict the true prevalence rates for each anatomical area according to each skeletal collection with the exception of Bowling Green Lane. In order to maintain fewer categories in Figure 5.19, the true rates where rounded to the closest number. Figure 5.20 groups the true rates of each collection according to the anatomical areas to facilitate their comparison. Graphs for each skeletal collection depicting the crude and true rates for each anatomical area are presented in Appendix 4 (section 4.3.1).

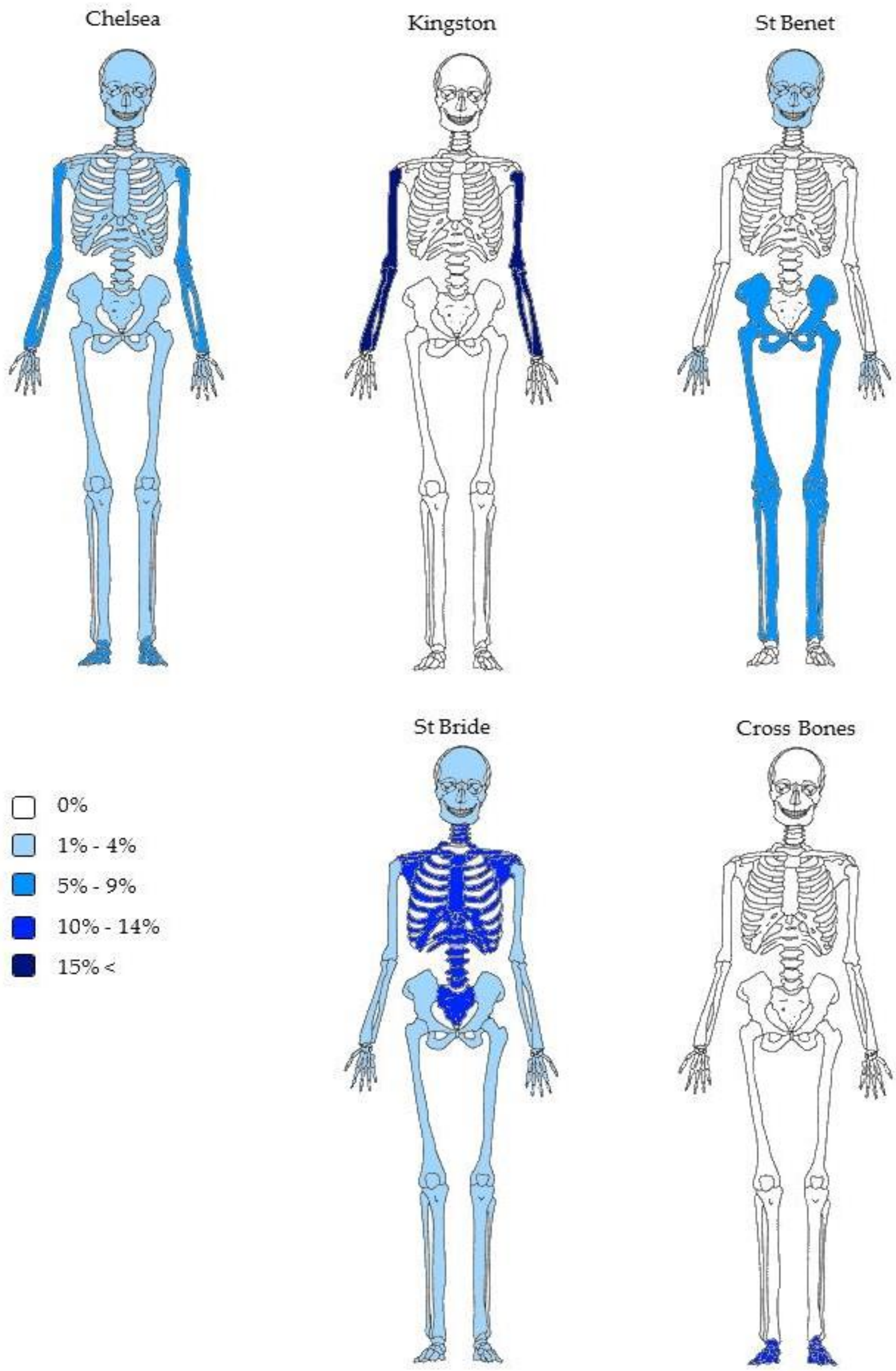


Figure 5.19 - The true fracture prevalence rates for each anatomical area according to the young adults in each skeletal collection which the exception of Bowling Green Lane.

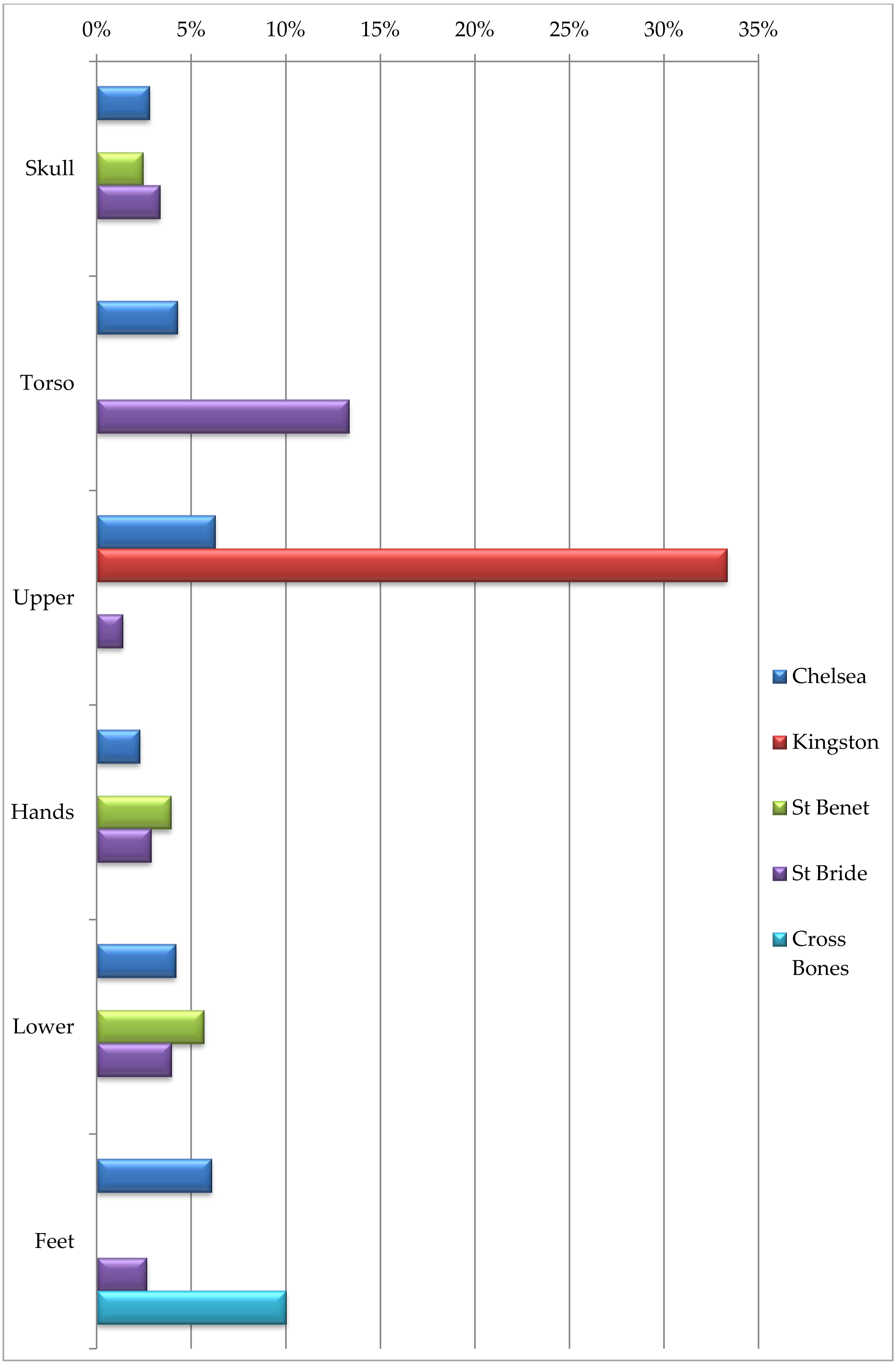


Figure 5.20 - The true prevalence rates for each anatomical area in each collection for the YA sample.

5.5.2 Chi-squared test results

The data for each anatomical area, in each individual collection, and then layered according to each age category, were entered into one chi-squared test. This test presents the results found for each age category as well as for when the three age categories are compared (Appendix 4, section 4.3.4).

When observing the results for the YA, they indicated that the differences between the collections in each anatomical location were statistically significant ($\chi^2 = 5.258$, df = 4, $p = 0.032$). The results were valid and acceptable as only 20% of the cases had an expected count lower than five and the lowest count was 1.24 which is larger than the minimum of one.

However, when looking more closely at the results from the same test, comparing the collections according to each anatomical area was not possible due to each anatomical area having 50% or more of their expected counts that were lower than five. Consequently, those results are not valid (Appendix 4, section 4.3.4).

5.5.3 Standardised rate ratios

The standardised rate ratios were calculated for every fracture site seen within the YA population of every skeletal collection. Since the sample was divided according to age, sex will be the standardising variable throughout this section and the subsequent equivalent sections for the middle and old adults.

5.5.3.1 Skull

Three collections were able to be cross-compared when analysing the fractures located on the skull. The standardised rate ratio for Chelsea and St Benet is equivalent to one. As a result, neither collection is more likely to have a YA with a fracture at this anatomical location than the other. On the other hand, this indicates that St Bride is 1.34 times more likely than both Chelsea and St Benet to have an individual from this age category with a fracture located on the skull.

5.5.3.2 Torso

Table 5.18 displays the ratios found between the collections when comparing the fractures on the torso. Kingston's standard fracture ratio was zero and as a result any comparison featuring that collection will be invalid and is indicated in the table by "n/a". The highest ratio reveals that Cross Bones is 5.38 times more likely to have a YA with a fracture located on the torso than St Benet. The lowest ratio indicates that the YA were only 1.1 times more likely to have a fracture at this location if they were from Cross Bones rather than St Bride.

Table 5.18 - The standardised rate ratios (SRR) for fractures on the torso for pair-wise comparisons between the YA of each collection.

	SRR	**Compared with:**
Chelsea	n/a	Kingston
Chelsea	2.16 : 1	St Benet
Chelsea	1 : 2.27	St Bride
Chelsea	1 : 2.49	Cross Bones
Kingston	n/a	St Benet
Kingston	n/a	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 4.89	St Bride
St Benet	1 : 5.38	Cross Bones
St Bride	1 : 1.1	Cross Bones

5.5.3.3 Upper limbs

When the ratios were calculated for fractures located on the upper limbs, only one comparison was possible. As a result, the YA are 4.69 times more likely to have suffered a fracture located on the upper limbs over the course of their lifetime if they were exhumed from the Chelsea burial ground rather than from the St Bride burial ground. All other comparisons were invalid due to the other collections having a standard fracture ratio of zero.

5.5.3.4 Hands

As for the fractures of the hands, three collections yielded a standard fracture ratio. St Benet is 1.8 times more likely than Chelsea and 1.43 times more likely than St Bride to have a YA with this type of fracture. This is again one of the rarer occasions when St Benet is the most likely collection to have individuals with a fracture when compared to others, especially St Bride. Lastly, St Bride is 1.26 times more likely than Chelsea to have a YA with fracture on the hands. All the other comparisons were invalid.

5.5.3.5 Lower limbs

The lower limbs see a ratio between Chelsea and St Bride where the latter is only 1.12 times more likely to have a YA exhibiting that type of fracture than the former. Furthermore, St Benet is 1.35 times more likely than Chelsea, and 1.57 times more likely than St Bride to have a YA with a fracture located on the lower limbs. This is a reflection of what was seen in the hands, and the ratio between St Benet and St Bride is the highest ratio for this anatomical area. All other comparisons were invalid due to Kingston and Cross Bones having a standard fracture ratio equivalent to zero.

5.5.3.6 Feet

When the standard fracture ratios were calculated for fractures on the feet, Kingston's and St Benet's equalled zero and as a result, any comparison featuring either of these collections will be invalid. However, Cross Bones is 1.74 times more likely than Chelsea and 4.08 times more likely than St Bride to have a YA with a fracture on the feet. Finally, Chelsea is 2.34 times more likely to have an individual with a fracture in that area than St Bride.

5.6 MIDDLE ADULTS

5.6.1 Prevalence rates

The calculations found in section 5.2 were re-calibrated in order to demonstrate the prevalence rates found within the middle adults (MA) of the sample. Table 5.19 presents the number of MA with a fracture within each anatomical area as well as the number of MA who have at least one bone present in each area. The torso has the highest number (n = 35) of affected MA while the MA with fractures on the hands and on the feet both have the lowest number (n = 8).

Table 5.19 - The number of MA with a fracture (N.F) for each anatomical area, as well as the number of MA with a bone present in each anatomical area.

Bone	N.F	MA with bone present
Skull	21	176
Torso	35	221
Upper	15	219
Hands	8	201
Lower	17	225
Feet	8	170

Figure 5.21 presents the two crude prevalence rates which were calculated using the collective MA sample (n = 228) and the MA sample exhibiting fractures (n = 68). Furthermore, the true rates are provided in the figure below and are calculated using the number of individuals with bones present for each anatomical area found in each collection (Table 5.19). When looking at the crude and true rates, the highest for each rate, 15.35% and 15.84% respectively, is found in the torso. As for the lowest rate, the hands and feet are almost identical. However, the hands do have a slightly lower true fracture prevalence rate (3.98%) than the feet (4.71%).

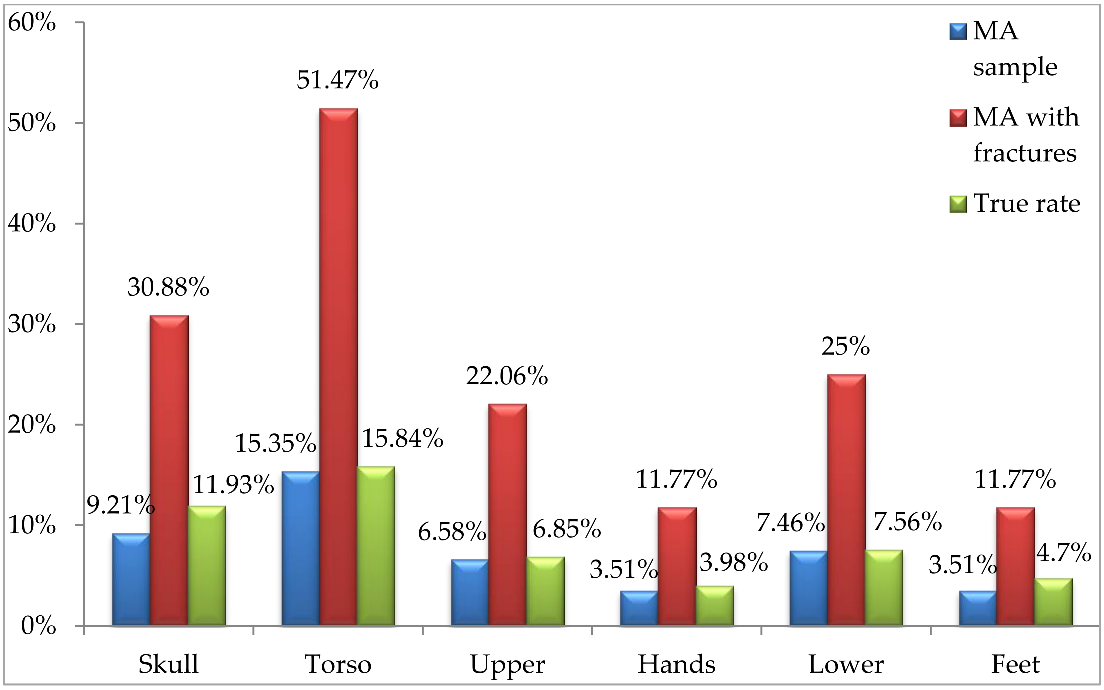


Figure 5.21 - The crude prevalence rates for the total MA sample (n = 228), with the exception of Bowling Green Lane, and the sample of MA with a fracture (n = 68) as well as the associated true rates for each anatomical area.

Table 5.20 - The number of MA with a fracture (N.F), the number of MA with a bone present in each anatomical area, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	MA with bone present	True prevalence rate
Chelsea (n = 43)				
Skull	4	9.3%	26	15.39%
Torso	5	11.63%	42	11.91%
Upper	3	6.98%	40	7.5%
Hands	1	2.33%	34	2.94%
Lower	3	6.98%	43	6.98%
Feet	2	4.65%	24	8.33%
Kingston (n = 10)				
Skull	0	0%	10	0%
Torso	0	0%	9	0%
Upper	1	10%	10	10%
Hands	0	0%	6	0%
Lower	0	0%	10	0%
Feet	0	0%	9	0%

Table 5.20 cont. - The number of MA with a fracture (N.F), the number of MA with a bone present in each anatomical area, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	MA with bone present	True prevalence rate
St Benet (n = 38)				
Skull	1	2.63%	29	3.45%
Torso	4	10.53%	35	11.43%
Upper	3	7.9%	38	7.9%
Hands	1	2.63%	36	2.78%
Lower	1	2.63%	37	2.7%
Feet	1	2.63%	32	3.13%
St Bride (n = 118)				
Skull	15	12.71%	96	15.63%
Torso	20	16.95%	118	16.95%
Upper	7	5.93%	114	6.14%
Hands	5	4.24%	110	4.55%
Lower	11	9.32%	118	9.32%
Feet	4	3.4%	89	4.49%
Cross Bones (n = 17)				
Skull	2	11.76%	15	13.33%
Torso	5	29.41%	17	29.41%
Upper	1	5.88%	17	5.88%
Hands	1	5.88%	15	6.67%
Lower	2	11.76%	17	11.76%
Feet	1	5.88%	16	6.25%

Table 5.20 represents the same information as above while being demarcated by the individual collections. In every skeletal collection, with the exception of Kingston, the highest true prevalence rate is found within the fractures located on the torso. Kingston does not have a rate for that particular anatomical site and the only rate (10%, representative of both the crude and true rate) is found within the fractures of the upper limbs.

Figures 5.22 and 5.23 depict the true prevalence rates for each anatomical area according to each skeletal collection with the exception of Bowling Green Lane. In order to maintain fewer categories in Figure 5.22, the true rates where rounded to the closest number. Figure 5.23 presents the true rates of each collection according to each anatomical area so that the comparison for each area is easily understood. Graphs for each skeletal collection depicting the crude and true rates for each anatomical area are presented in Appendix 4 (section 4.3.2).

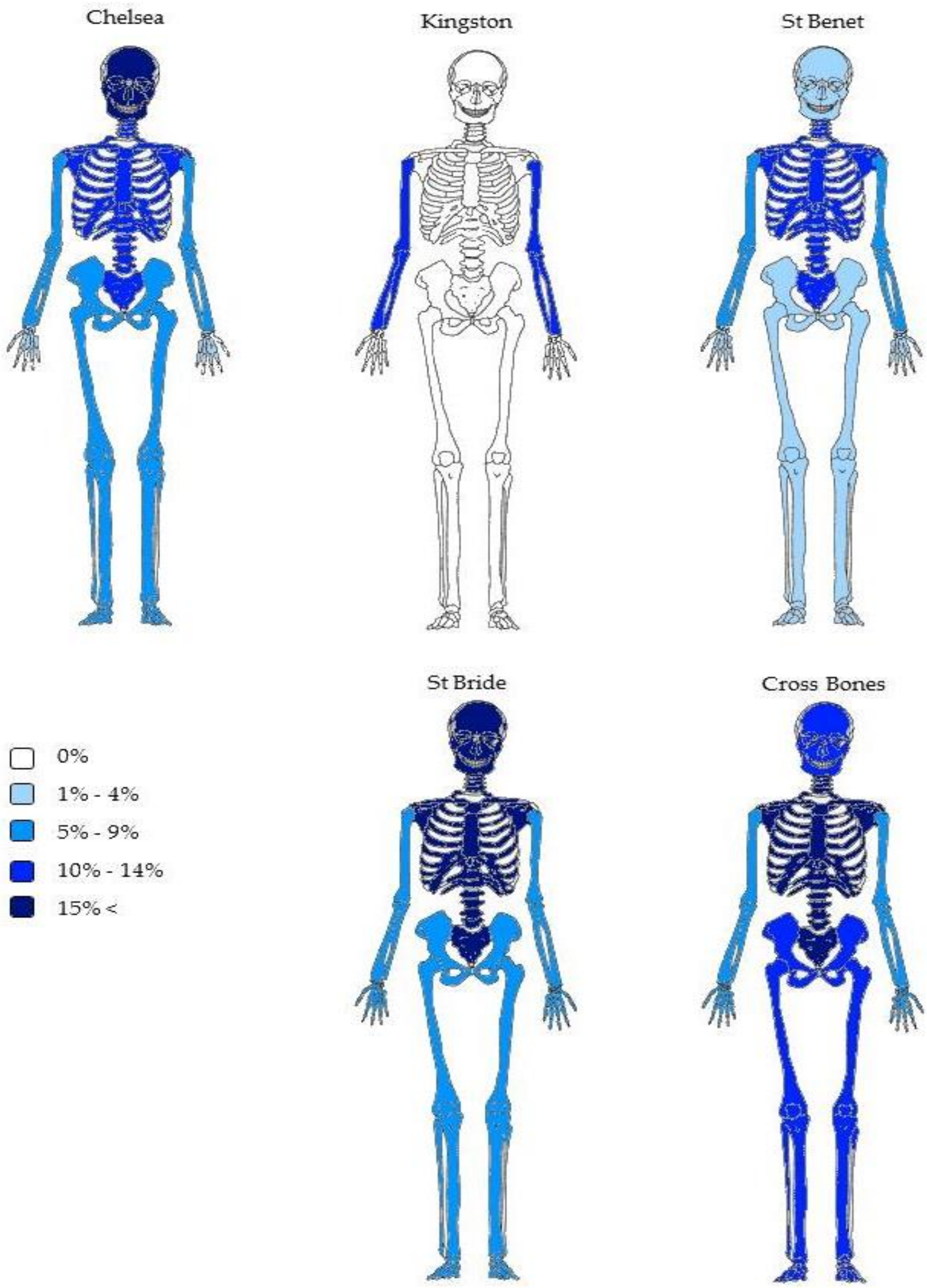


Figure 5.22 - The true fracture prevalence rates for each anatomical area according to the middle adults in each skeletal collection which the exception of Bowling Green Lane.

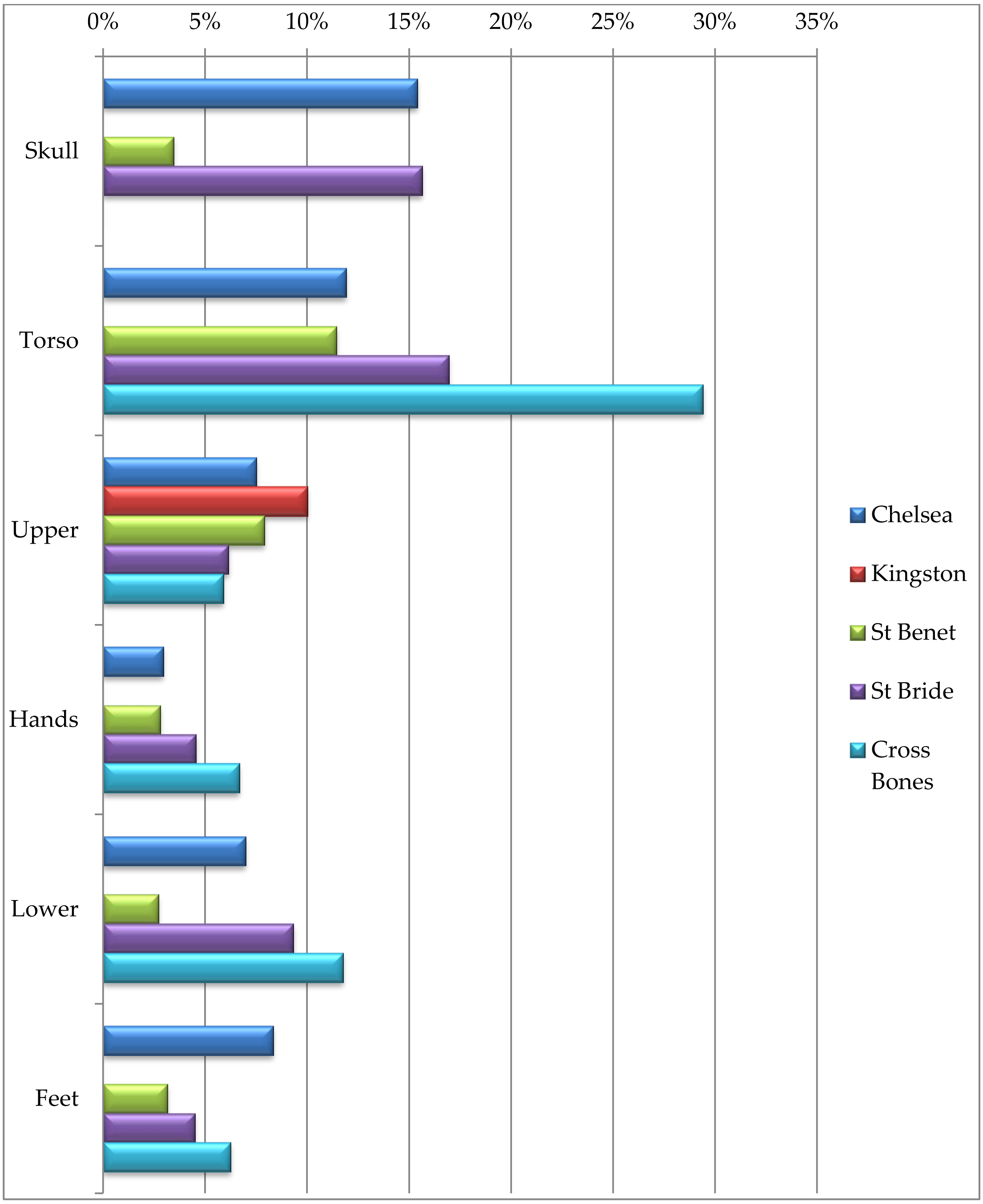


Figure 5.23 - The true prevalence rates for each anatomical area in each collection for the MA sample.

5.6.2 Chi-squared test results

Using the same chi-squared test as in section 5.5.2, the different rates seen in the various collections, when observing the MA population, is statistically significant (χ^2 = 8.585, df = 4, p = 0.005) when the anatomical areas are grouped together. Only one expected count (10%) was lower than five and had a value of 4.63 which permits the presentation of the above result (Appendix 4, section 4.3.4).

When looking at the differences seen between the collections in each anatomical area, stemming from the same chi-squared test, only the results from the torso are permissible. The result is statistically significant (χ^2 = 5.239, df = 4, p = 0.034) and acceptable due to only 20% of the expected counts being lower than five and the minimum count equalling 1.38. All the other anatomical areas had at least 40% of their respective expected counts equalling less than five and subsequently they are not presentable (Appendix 4, section 4.3.4).

5.6.3 Standardised rate ratios

The standardised rate ratios were calculated for every fracture site seen within the MA population of every skeletal collection.

5.6.3.1 Skull

Table 5.21 displays the ratios found between the collections when comparing the fractures on the skull. Kingston's standard fracture ratio was zero and as a result any comparison featuring that collection will be invalid which is indicated by "n/a" in the table. The standardised rate ratio for Chelsea and St Bride equals one. Consequently, neither collection is more likely to have a MA with a fracture located on the skull than the other. The highest ratio indicates that the MA from Cross Bones are 5.78 times more likely to have suffered a fracture on the skull during their lifetime than if they had been exhumed from St Benet. The lowest ratio indicates that Cross Bones is only 1.04 times more likely to have a MA with a fracture at this location than both Chelsea and St Bride.

Table 5.21 - The standardised rate ratios (SRR) for fractures on the skull for pair-wise comparisons between the MA of each collection.

	SRR	Compared with:
Chelsea	n/a	Kingston
Chelsea	5.56 : 1	St Benet
Chelsea	1	St Bride
Chelsea	1 : 1.04	Cross Bones
Kingston	n/a	St Benet
Kingston	n/a	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 5.55	St Bride
St Benet	1 : 5.78	Cross Bones
St Bride	1 : 1.04	Cross Bones

5.6.3.2 Torso

Standard fracture ratios were available for every collection regarding fractures located on the torso and are presented in Table 5.22. Furthermore, as seen above, the result for the chi-squared test for this anatomical area was statistically significant. The highest ratio indicates that the MA are 2.08 times more likely to have a fracture located on the torso if they are from Cross Bones rather than St Benet. The lowest ratio indicates that the MA from Kingston are only 1.07 times more likely to have suffered a fracture on the torso than if they had been exhumed from Chelsea.

Table 5.22 - The standardised rate ratios (SRR) for fractures on the torso for pair-wise comparisons between the MA of each collection.

	SRR	Compared with:
Chelsea	1 : 1.07	Kingston
Chelsea	1.22 : 1	St Benet
Chelsea	1 : 1.3	St Bride
Chelsea	1 : 1.71	Cross Bones
Kingston	1.3 : 1	St Benet
Kingston	1 : 1.22	St Bride
Kingston	1 : 1.6	Cross Bones
St Benet	1 : 1.58	St Bride
St Benet	1 : 2.08	Cross Bones
St Bride	1 : 1.31	Cross Bones

5.6.3.3 Upper limbs

Figure 5.24 illustrates the standardised rate ratios for the collections when looking at the upper limbs. In this case, the MA from Kingston are always more likely to have a fracture on the upper limbs than the other collections. The highest ratio shows that they are 3.65 times more likely to have a fracture on the upper limbs than the MA from Cross Bones. On the other hand, Cross Bones is always the least likely to have an MA with a fracture at this location. As a result, the lowest ratio indicates that St Bride is only 1.18 times more likely than Cross Bones when observing the MA with a fracture on the upper limbs. The ratios for every pair-wise comparison can also be found in section 4.3.5.1 of Appendix 4.

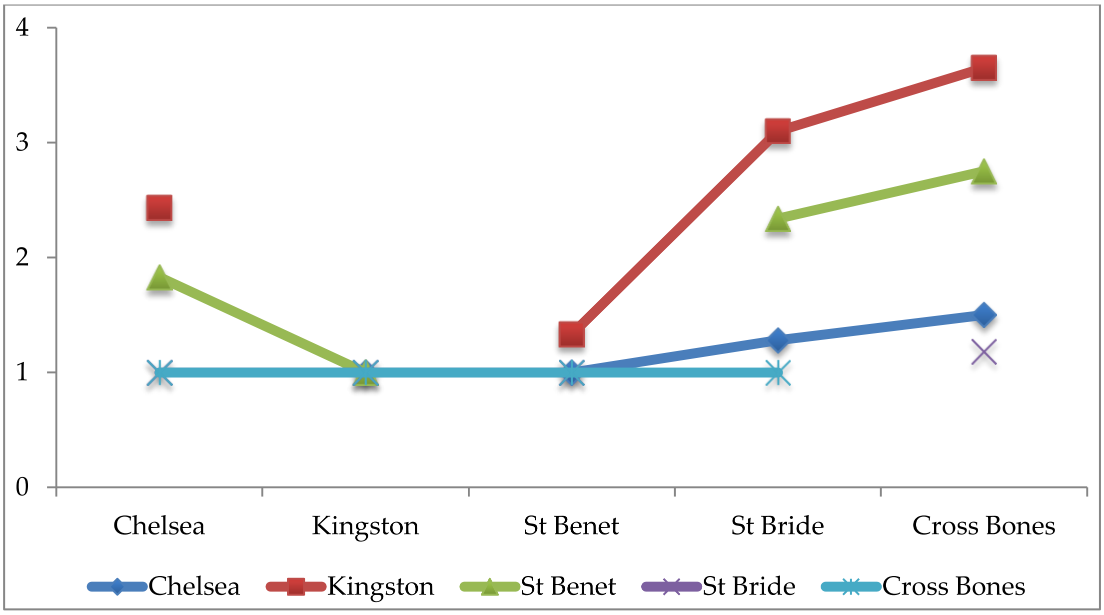


Figure 5.24 - The standardised rate ratios (SRR) for fractures on the upper limbs for pair-wise comparisons between the MA of each collection.

5.6.3.4 Hands

Table 5.23 displays the ratios found between the collections when comparing the fractures on the hands. Kingston's standard fracture ratio was zero and as a result any comparison featuring that collection will be invalid and is indicative by the "n/a" in the table. The highest ratio reveals that Cross Bones is 3.29 times more likely to have a MA with a fracture on the hands than those from St Benet. The lowest ratio finds that St Bride is 1.32 times more likely than Chelsea to have a MA with a fracture in the same location.

Table 5.23 - The standardised rate ratios (SRR) for fractures of the hands for pair-wise comparisons between the MA of each collection.

	SRR	Compared with:
Chelsea	n/a	Kingston
Chelsea	1.84 : 1	St Benet
Chelsea	1 : 1.32	St Bride
Chelsea	1 : 1.79	Cross Bones
Kingston	n/a	St Benet
Kingston	n/a	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 2.42	St Bride
St Benet	1 : 3.29	Cross Bones
St Bride	1 : 1.36	Cross Bones

5.6.3.5 Lower limbs

The situation is similar to what was seen in the fracture of the hands when observing the lower limbs (Table 5.24). Kingston's standard fracture ratio was zero; as a result, any comparison featuring that collection will be invalid and is indicated with "n/a" in the table. The highest ratio indicates that St Bride is 4.07 times more likely to have an MA with a fracture on the lower limbs than St Benet. As for the lowest ratio, St Bride is only 1.16 times more likely to exhibit this fracture in the MA population than Chelsea.

Table 5.24 - The standardised rate ratios (SRR) for fractures on the lower limbs for pair-wise comparisons between the MA of each collection.

	SRR	Compared with:
Chelsea	n/a	Kingston
Chelsea	3.5 : 1	St Benet
Chelsea	1 : 1.16	St Bride
Chelsea	1.16 : 1	Cross Bones
Kingston	n/a	St Benet
Kingston	n/a	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 4.07	St Bride
St Benet	1 : 3.01	Cross Bones
St Bride	1.35 : 1	Cross Bones

5.6.3.6 Feet

When the standard fracture ratios were calculated for fractures on the feet, Kingston's standard fracture ratio was again zero and as a result any comparison featuring that collection will be invalid and is indicated by "n/a" in Table 5.25. The highest standardised rate ratio is found between Chelsea and St Benet where MA from the former are 3.88 times more likely to have suffered a fracture on their feet during their lifetime than if they had come from the latter burial ground. On the other hand, the lowest ratio reveals that the MA from Cross Bones are 1.32 times more likely to display this type of fracture than those from St Bride.

Table 5.25 - Standardised rate ratios (SRR) for fractures on the feet for pair-wise comparisons between the MA of each collection.

	SRR	Compared with:
Chelsea	n/a	Kingston
Chelsea	3.88 : 1	St Benet
Chelsea	1.94 : 1	St Bride
Chelsea	1.47 : 1	Cross Bones
Kingston	n/a	St Benet
Kingston	n/a	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 2	St Bride
St Benet	1 : 2.64	Cross Bones
St Bride	1 : 1.32	Cross Bones

5.7 OLD ADULTS

5.7.1 Prevalence rates

The calculations found in section 5.2.1 were re-calibrated in order to demonstrate the fracture prevalence rates found within the old adults (OA) in the sample. Table 5.26 presents the number of OA with a fracture within each anatomical area as well as the number of OA with at least one bone present in each anatomical area. The torso has the highest number (n = 41) of affected OA while OA with fractures on the feet have the lowest number (n = 4).

Table 5.26 - The number of OA with a fracture (N.F) for each anatomical area, as well as the number of OA with a bone present in each anatomical area.

Bone	**N.F**	**OA with bone present**
Skull	15	133
Torso	41	163
Upper	18	161
Hands	11	152
Lower	18	166
Feet	4	120

Figure 5.25 presents the two crude prevalence rates which were calculated using the collective OA sample (n = 168), with the exception of Bowling Green Lane, and the OA sample with fractures (n = 77). Furthermore, the true rates are provided in Figure 5.25 and are calculated using the number of individuals with bones present for each anatomical area (Table 5.26). When looking at all the rates, the highest for each crude rate, 24.41% and 25.15%, respectively, is once again found in the torso. As for the lowest rates, they are found in the feet for each rate (2.38% and 3.33%).

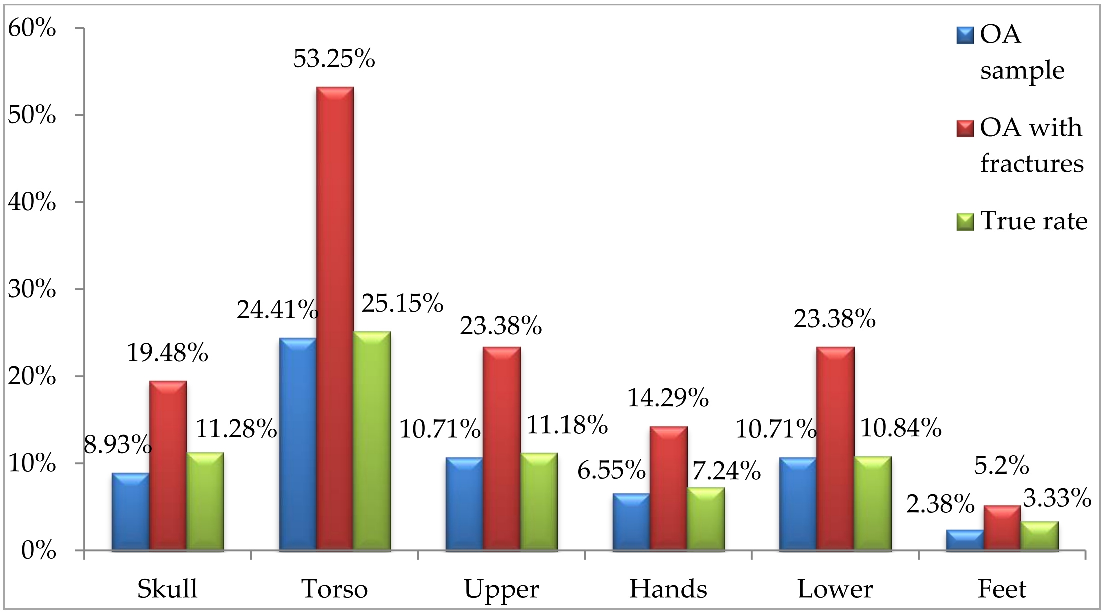


Figure 5.25 - The crude prevalence rates for the total OA sample (n = 168), with the exception of Bowling Green Lane, and the sample of OA with a fracture (n = 77) as well as the associated true rates for each anatomical area.

Table 5.27 represents the same information as above while being divided by the individual collections.

Table 5.27 - The number of OA with a fracture (N.F), the number of OA with a bone present in each anatomical area, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	OA with bone present	True prevalence rate
Chelsea (n = 43)				
Skull	1	2.33%	28	3.57%
Torso	6	13.95%	41	14.63%
Upper	2	4.65%	42	4.76%
Hands	3	6.98%	42	7.14%
Lower	5	11.63%	43	11.63%
Feet	0	0%	31	0%
Kingston (n = 18)				
Skull	0	0%	17	0%
Torso	1	5.56%	18	5.56%
Upper	4	22.22%	17	24.53%
Hands	0	0%	14	0%
Lower	1	5.56%	17	5.88%
Feet	1	5.56%	15	6.67%

Table 5.27 cont. - The number of OA with a fracture (N.F), the number of OA with a bone present in each anatomical area, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	OA with bone present	True prevalence rate
St Benet (n = 18)				
Skull	0	0%	11	0%
Torso	1	5.56%	17	5.88%
Upper	0	0%	16	0%
Hands	0	0%	17	0%
Lower	2	11.11%	18	11.11%
Feet	0	0%	14	0%
St Bride (n = 75)				
Skull	14	18.67%	63	22.22%
Torso	34	45.33%	73	46.58%
Upper	11	14.67%	72	15.28%
Hands	8	10.67%	69	11.59%
Lower	9	12%	73	12.33%
Feet	3	4%	48	6.25%
Cross Bones (n = 14)				
Skull	0	0%	14	0%
Torso	0	0%	14	0%
Upper	1	7.14%	14	7.14%
Hands	0	0%	10	0%
Lower	1	7.14%	14	7.14%
Feet	0	0%	12	0%

Unlike the situation with the MA population, the highest true fracture prevalence rates for the OA vary from one collection to another. The skeletons from Chelsea follow the lead of the MA population where the torso displays the highest rate (14.63%) while the highest in Kingston is found within the upper limbs (24.53%). The OA of St Benet have their highest true rate in an altogether different anatomical area, the lower limbs (11.11%), while the highest rate for St Bride is once again found in the torso (46.58%). Finally, there are only two anatomical areas within the OA population from Cross Bones that have a fracture prevalence rate. The crude and true rates for both the upper and lower limbs are all identical with 7.14%.

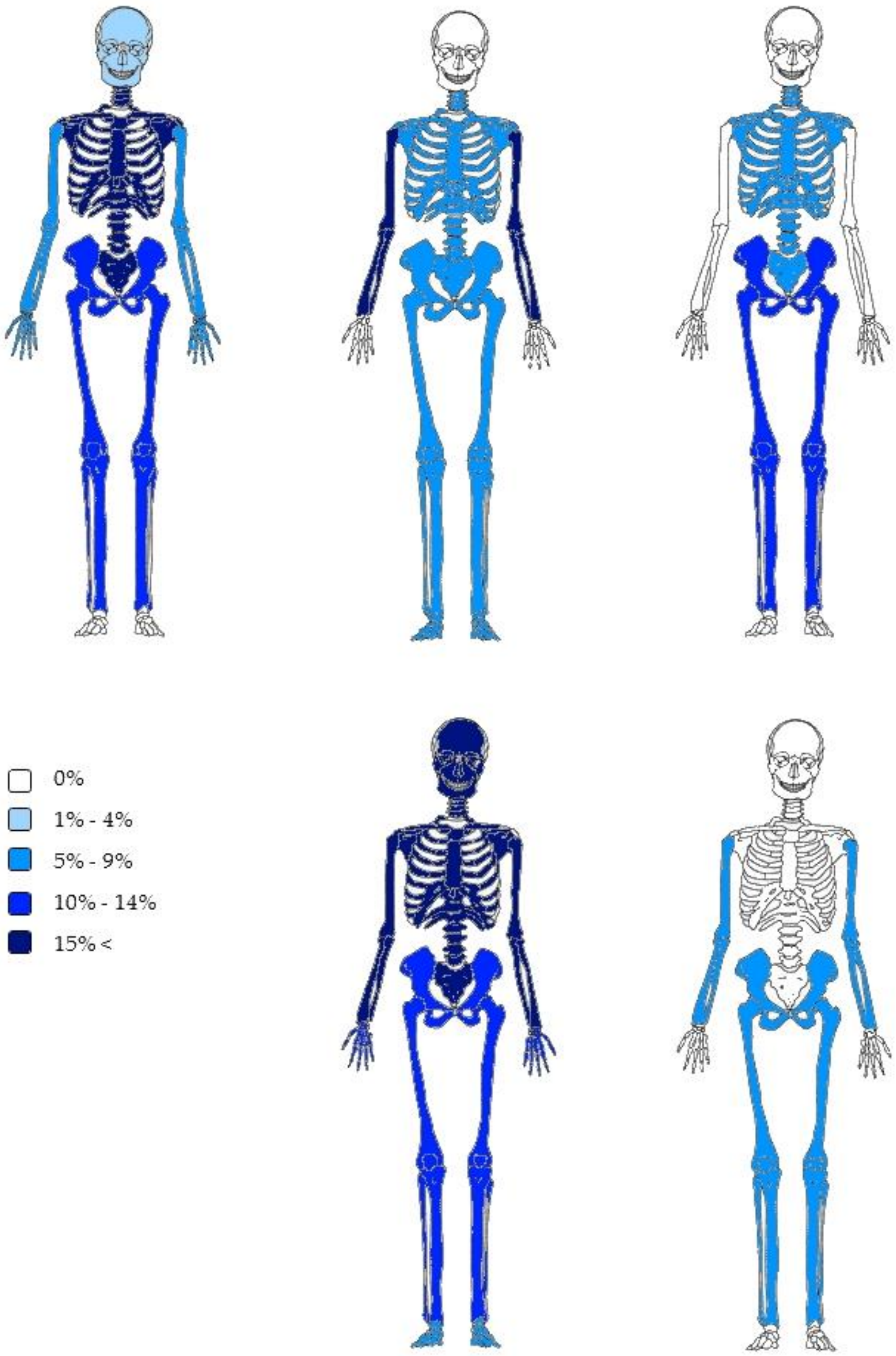


Figure 5.26 - The true fracture prevalence rates for each anatomical area according to the old adults in each skeletal collection which the exception of Bowling Green Lane.

Figures 5.26 and 5.27 depict the true prevalence rates for each anatomical area according to each skeletal collection with the exception of Bowling Green Lane. In order to maintain fewer categories in Figure 5.26, the true rates where rounded to the closest number. Furthermore, Figure 5.27 presents the skeletal collections when the true prevalence rates are grouped according to the anatomical areas. Graphs for each skeletal collection depicting the crude and true rates for each anatomical area are presented in Appendix 4 (section 4.3.3).

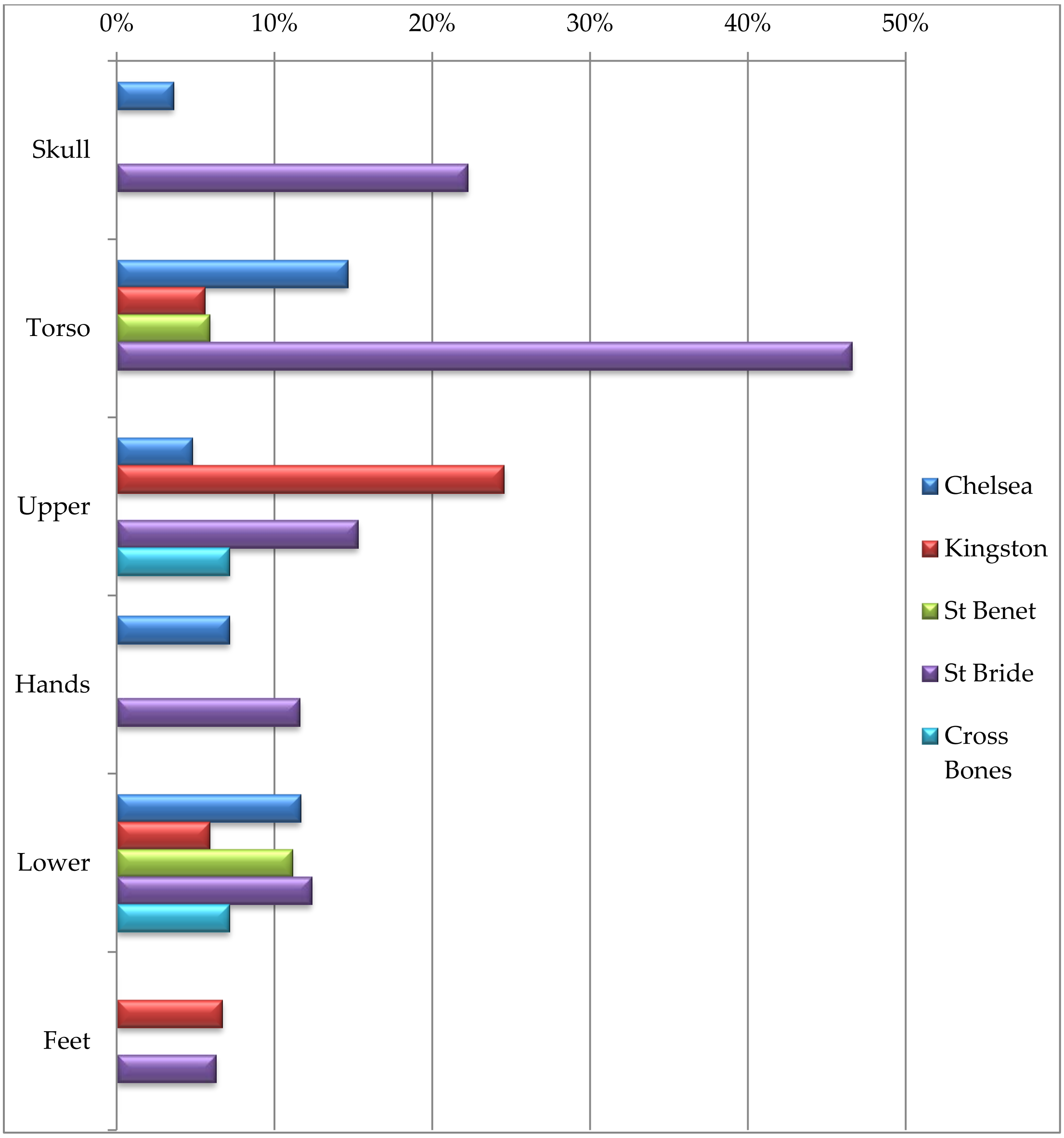


Figure 5.27 - The true prevalence rates for each anatomical area in each collection for the OA sample.

5.7.2 Chi-squared test results

When observing the OA in the chi-squared test, the results indicated that the differences seen between the collections when all the anatomical areas are analysed together is statistically significant ($\chi^2 = 43.013$, df = 4, $p < 0.001$). All the expected counts when observing the data for the OA had a value that was over five.

When observing the differences seen between the collections according to each anatomical area, the same test as above revealed that none of the results are permissible due to the fact that they all have 30% or higher of their expected counts that are lower than five (Appendix 4, section 4.3.4).

5.7.3 Standardised rate ratios

The standardised rate ratios were calculated for every fracture site seen within the OA population of every skeletal collection.

5.7.3.1 Skull

The fractures located on the skull only yielded two collections with a standard fracture ratio. As a result, St Bride is 5.27 times more likely to have an OA in its population exhibiting a fracture at that location than those from Chelsea. All other comparisons were not possible.

5.7.3.2 Torso

Standard fracture ratios were available for all the collections regarding fractures located on the torso with the exception of Cross Bones. As a result, any comparison which features that collection will not yield a result and is indicated with “n/a” in Table 5.28. Based on the table, Kingston and St Benet have a standardised rate ratio of one which reveals that neither collection is more likely than the other to have an OA with a fracture on the torso. The highest ratios show that St Bride is 6.07 times more likely to have an OA with a fracture in this area than both Kingston and St Benet. Furthermore, the lowest ratios indicate that the OA are 1.9 times more likely to have a fracture on the torso if they came from the Chelsea burial ground rather than either Kingston or St Benet.

Table 5.28 - The standardised rate ratios (SRR) for fractures on the torso for pair-wise comparisons between the OA of each collection.

	SRR	Compared with:
Chelsea	1.9 : 1	Kingston
Chelsea	1.9 : 1	St Benet
Chelsea	1 : 3.19	St Bride
Chelsea	n/a	Cross Bones
Kingston	1	St Benet
Kingston	1 : 6.07	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 6.07	St Bride
St Benet	n/a	Cross Bones
St Bride	n/a	Cross Bones

5.7.3.3 Upper limbs

Figure 5.28 illustrates the standardised rate ratios for the collections when looking at the upper limbs and a standard fracture ratio was available for all collections. The highest standardised rate ratio shows that the OA are 9.13 times more likely to have a fracture in the upper limbs when they are from Kingston rather than Chelsea. This is the highest standardised rate ratio seen so far in this chapter. On the other hand, the lowest ratio indicates that the OA from St Benet are only 1.01 times more likely than those from Cross Bones to have a fracture located at this anatomical area. The ratios for every pair-wise comparison can also be found in section 4.3.6.1 of Appendix 4.

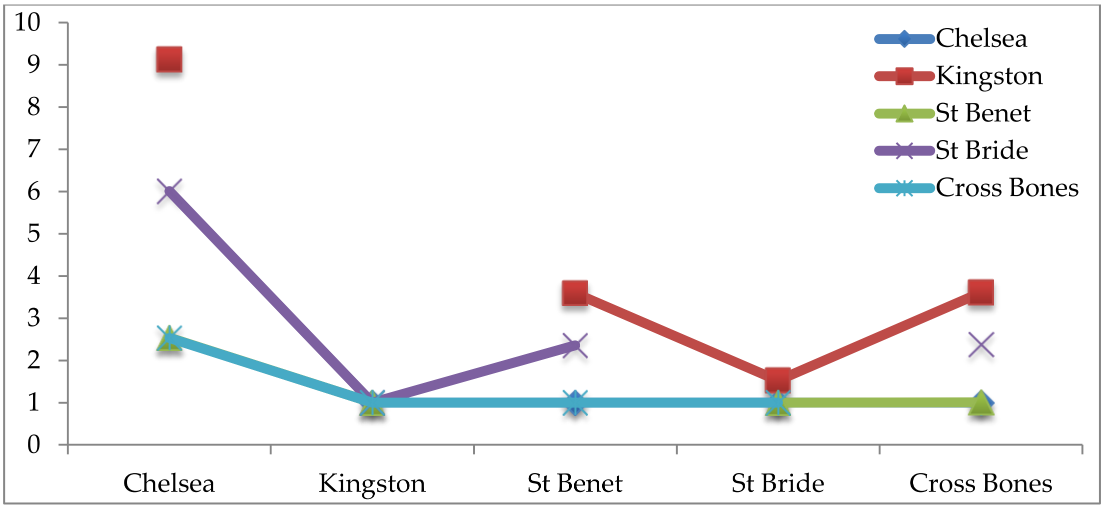


Figure 5.28 - Standardised rate ratios (SRR) for fractures on the upper limbs for pair-wise comparisons between the OA of each collection.

5.7.3.4 Hands

There are only two collections who presented a standard fracture ratio when comparing the fractures on the hands, Chelsea and St Bride. As a result, the OA are 1.58 times more likely to have a fracture on the hands if they are from St Bride rather than if they were exhumed from the Chelsea burial ground. All other comparisons were not possible due to the other collections having a standard fracture ratio equalling zero.

5.7.3.5 Lower limbs

Similarly to the upper limbs, the lower limbs have stemmed a standard fracture ratio for each collection (Table 5.29). The highest standardised rate ratio indicates that St Bride is 2.15 times more likely to have an OA with a fracture on the lower limbs than Kingston. As for the lowest ratio, Chelsea is only 1.03 times more likely to have a fracture at this location compared to the OA from St Benet. St Benet is also only 1.03 times more likely to have an OA with a fracture on the lower limbs than Cross Bones.

Table 5.29 - The standardised rate ratios (SRR) for fractures on the lower limbs for pair-wise comparisons between the OA of each collection.

	SRR	Compared with:
Chelsea	1.37 : 1	Kingston
Chelsea	1.03 : 1	St Benet
Chelsea	1 : 1.57	St Bride
Chelsea	1.06 : 1	Cross Bones
Kingston	1 : 1.33	St Benet
Kingston	1 : 2.15	St Bride
Kingston	1 : 1.29	Cross Bones
St Benet	1 : 1.63	St Bride
St Benet	1.03 : 1	Cross Bones
St Bride	1.67 : 1	Cross Bones

5.7.3.6 Feet

When the standard fracture ratios were calculated for fractures on the feet, only two collections were available for comparison. In this case, Kingston is 1.18 times more likely to have an individual in the OA population with a fracture at that location than those from St Bride. All other comparisons were not possible.

5.8 Comparison between the age categories

5.8.1 Prevalence rates

The rates for each age category, divided by anatomical area and by collection, are presented in Figure 5.29 in order to gain a better understanding of the fractures' distribution based on their anatomical location and how they affect the different age categories.

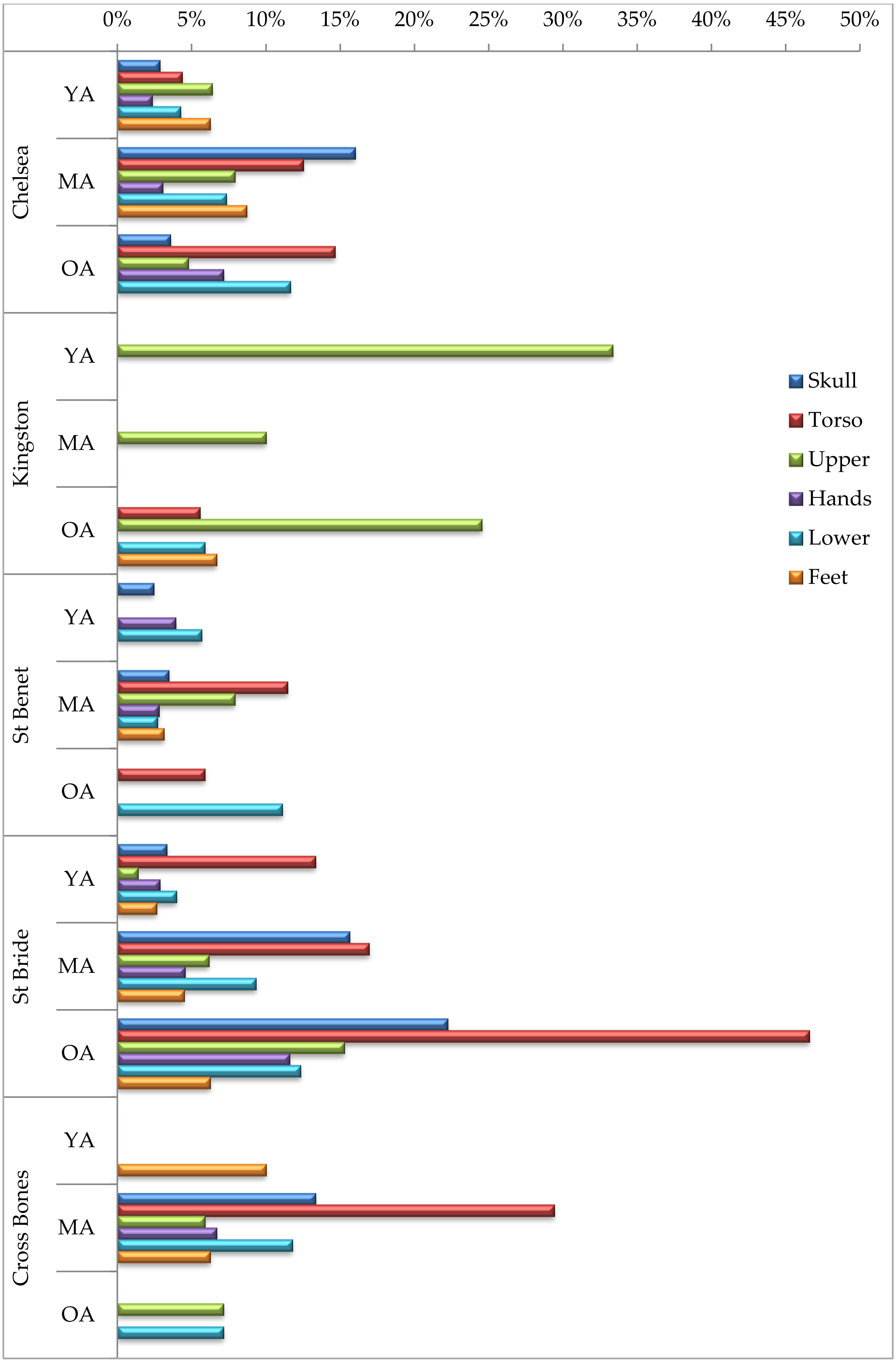


Figure 5.29 - The true prevalence rates for each anatomical area as well as for each age category in each collection.

5.8.2 Chi-squared test results

Using the same chi-squared test that was used in the individual age categories (Appendix 4, section 4.3.4), it was found that the differences between the anatomical areas, when all the age categories were compared, is statistically significant ($\chi^2 = 41.293$, df = 4, $p < 0.001$).

When looking at the comparison of the age categories according to the individual anatomical areas, the results for the differences between the collections were presentable for the skull, the torso, the upper limbs and the lower limbs (Appendix 4, section 4.3.4). In all of these different areas, a maximum 20% of the expected counts were lower than five, yet the minimum was all above the value of one which is permissible. The results were statistically significant for the skull ($\chi^2 = 16.192$, df = 4, $p < 0.001$), the torso ($\chi^2 = 32.229$, df = 4, $p < 0.001$) and the upper limbs ($\chi^2 = 14.099$, df = 4, $p = 0.001$).

5.8.3 Standardised rate ratios

When calculating the standardised rate ratios for the age categories, the collections were grouped together in order to properly comprehend which age category is more likely to have an individual with a fracture in each anatomical area. Since the sample was divided according to age, sex will be the standardising variable.

5.8.3.1 Skull

In this case, neither the MA nor the OA are more likely to have an individual with a fracture located on the skull than the other. Consequently, the MA and OA are both 4.44 times more likely to have an individual with a fracture at this location that the YA.

5.8.3.2 Torso

The MA are twice as likely to have an individual with a fracture at this location compared to the YA. The OA are also 3.33 times more likely than the YA to have an individual with a fracture on the torso. Lastly, the OA are 1.67 times more likely than the MA.

5.8.3.3 Upper limbs

The upper limbs follow the same pattern seen in the torso. The ratio indicates that the MA are 3.62 times, and the OA are 5.72 times more likely than the YA to have a fracture located on the upper limbs. Furthermore, the OA are also 1.58 times more likely than the MA to have an individual in their population with a fracture at this location.

5.8.3.4 Hands

The standardised rate ratios for fractures on the hands are lower than previously seen. The MA are 1.2 times, while the OA are 2.3 times more likely to have a fracture at that location than the YA population. Furthermore, the ratio between MA and OA indicates that the latter population is 1.92 times more likely to have an individual with a fracture located on the hands than the former. This ratio is higher than what is seen when comparing the YA with the MA for this anatomical area. Based on the previous comparisons, the ratios between MA and OA have been lower than the one between YA and MA.

5.8.3.5 Lower limbs

When analysing the lower limbs, it is found that the MA population is 1.63 times more likely, and the OA population is 2.57 times more likely to have an individual with a fracture on the lower limbs than if the individual was part of the YA population. Furthermore, the OA population is also 1.58 times more likely to have an individual exhibit a fracture at this location than if they were part of the MA population.

5.8.3.6 Feet

Finally, the fractures of the feet show results that do not follow the pattern laid out above. In this case, the YA population is 1.15 times more likely and the MA population is 1.28 times more likely to have an individual in their respective age categories with a fracture on the feet when compared to the OA population. On the other hand, the MA are 1.12 times more likely to have an individual with a fracture on the feet than the YA.

Summary

This chapter categorises the fractures seen on the skeletal material into anatomical areas with the intent to better visualise their dispersion on the body and begin to have an idea of the patterns they reveal.

Overall, the torso is the region with the most fractures. While the fractures on the torso have the highest overall true prevalence rate, the lowest is found in the feet for both sexes and for the old adults. The lowest true rate for the young adults is found within the fractures located on the feet as well as fractures on the skull, while the middle adults see their lowest rate on the hands. When observing the highest true fracture prevalence rate found in each collection and separated according to age and sex, it is found that male sample's highest true rate is always seen in the torso for every burial ground. However, when looking at the collections within the other anatomical areas, the highest true fracture prevalence rates will more often than not vary between the torso, the upper limbs and the lower limbs. There are some burial grounds that have a more consistent anatomical area with the highest true prevalence rate. For example, the collection from Kingston sees its highest fracture rate in the upper limbs for all groups with the exceptions of the males. Furthermore, the collection from St Benet has its highest rate in the lower limbs with the exception of the male sample and the MA sample. Finally, it is found that habitually the males have higher true prevalence rates for every anatomical site when compared to the females, with the exception of the upper limbs were the females have a higher rate. It is with anticipation that further exploration in the collections' respective social and economic context will clarify the reasons behind the discrepancies seen in the varying collections.

When observing the chi-squared test results, it was found that the differences seen between the collections, when the data for each anatomical area was analysed together, are statistically significant. This was a recurrent theme when both sexes and all of the age categories were explored. In some cases, it was permissible to present the statistical results of the individual anatomical areas. The collective sample and the MA present significant results of the fractures on the torso, while the males display that outcome for the fractures on the skull, the torso and the lower limbs.

Mirroring the prevalence rates, the males are more likely than the females to exhibit a fracture in all of the anatomical areas with one exception, the upper limbs. Furthermore, the highest ratio between the sexes was found in the hands, which could be an indicator that men are more prone to participate in fisticuffs. As for the ratios, the majority of the anatomical areas follow what was already seen demonstrating that the older individuals will have more fractures in each area than the other age categories with the exception of the feet where the younger adults are more likely to have a fracture at that location.

Consequently, further exploration into the socioeconomic circumstances of each collection is essential in order to fully understand the results that are presented by the data. This will be further explored and discussed in Chapter 7.

However, prior to undertaking the analysis and discussion of the above results and those from the previous chapter, it is essential to explore the presence of fractures that are more commonly associated with incidents of interpersonal violence. The next chapter will explore these possible markers of interpersonal violence and follow the development seen in this and the previous Results chapter.

Chapter 6
Results – Possible markers of interpersonal violence

This chapter solely focuses on the fractures that have been identified in the literature as possible markers of interpersonal violence. Based on the two previous Results chapters, fractures were present in every burial ground and in every sex or age group; furthermore, fractures were found to be located all over the body. The possible presence of interpersonal violence can now be explored in much more detail by observing the presence and prevalence of the five possible markers of interpersonal violence. These fractures are: depressed cranial fractures, nasal fractures, ulnar fractures, rib fractures and metacarpal fractures. A full description of these fractures and their aetiology can be found in section 2.2.6 of Chapter 2.

The current chapter follows the development and organisation presented in the two previous Results chapters. The tables and headings will display the word 'cranium' when referring to the depressed cranial fractures. Furthermore, the tables will display 'MC' when referring to the metacarpals.

6.1 COLLECTIVE SAMPLE

In this preliminary sub-section, there is no delineation regarding the individual collections or the individuals' age or sex. The aim is to observe the amount of affected individuals from the collective sample who display possible markers of interpersonal violence.

6.1.1 Prevalence rates

Table 6.1 presents the number of individuals with a fracture found for each of the fracture sites more commonly associated with interpersonal violence. True fracture prevalence rates were not possible at this time for the collective sample due to the incomplete skeletal inventory from Bowling Green Lane, whose affected individuals are included in the table. However, when the rates are divided based on each individual collection (Table 6.2), the true rates will be calculated for the remaining collections.

Table 6.1 - The number of individuals with a fracture (N.F), for each possible marker of interpersonal violence, in the collective sample.

Bone	**N.F**
Cranium	28
Nasal	44
Ulna	23
Ribs	115
Metacarpals (MC)	28

Similarly to what is seen in section 5.1.1 of the previous chapter, two crude prevalence rates were calculated when determining the number of individuals presenting fractures that are possible markers for interpersonal violence (Figure 6.1). The two rates stem from comparing the number of individuals displaying a possible marker with the collective sample (n = 1268), which includes individuals who do not present any fractures, as well as comparing them with the sample of individuals exhibiting a fracture regardless of its specific type or location (n = 343). In this case, the highest prevalence rates are seen in the ribs for both crude rates. When observing the collective sample, 9.07% of individuals have a rib fracture. However, that number greatly increases when only looking at the individuals with a fracture where 33.53% will have a rib fracture. The lowest rates are associated with the fractures of the ulna where 1.81% of the collective sample and 6.71% of the sample with fractures have this particular injury (Figure 6.1).

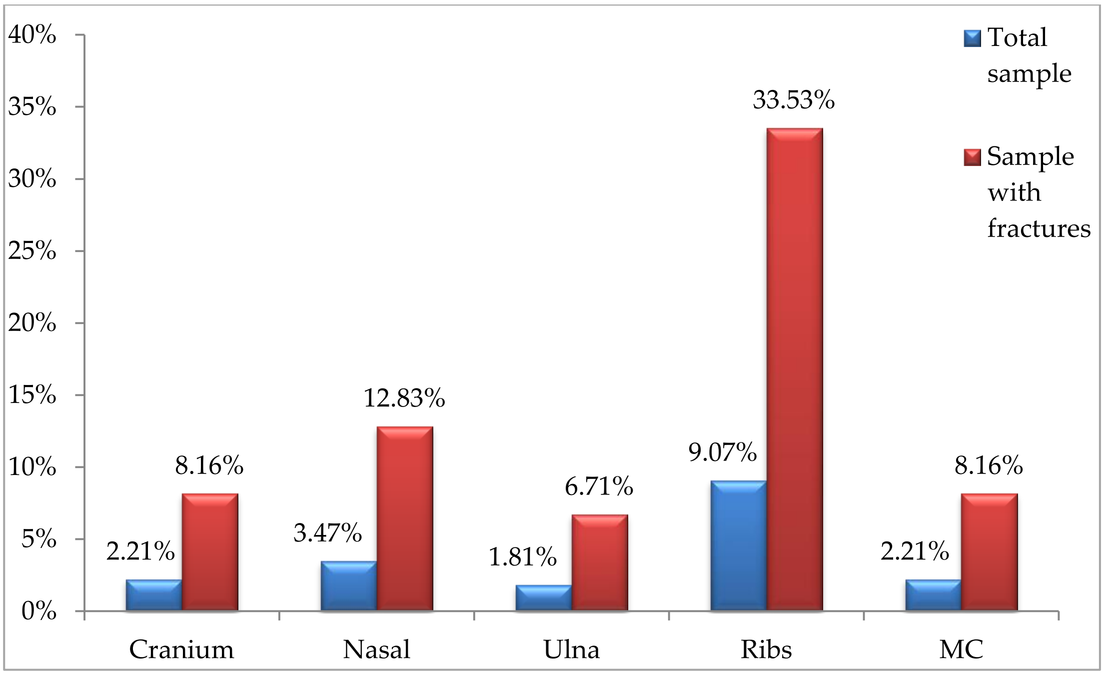


Figure 6.1 - The crude prevalence rates for the total sample (n = 1268) and the sample of individuals with a fracture (n = 343) when observing the possible markers for interpersonal violence.

Table 6.2 represents the same information as above while being redistributed according to the individual collections. The true prevalence rates were calculated using the number of individuals with the particular bone present found in the table; since they are not calculable for Bowling Green Lane, they appear as "n/a" in the table. The crude rates are calculated using the total number of individuals in each collection.

Table 6.2 - The number of individuals with a fracture (N.F), the number of individuals with a bone present for each possible marker of interpersonal violence, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	Individuals with bone present	True prevalence rate
Chelsea (n = 165)				
Cranium	3	1.82%	113	2.65%
Nasal	3	1.82%	50	6%
Ulna	2	1.21%	142	1.41%
Ribs	10	6.06%	126	7.94%
MC	5	3.03%	132	3.79%

Table 6.2 cont. - The number of individuals with a fracture (N.F), the number of individuals with a bone present for each possible marker of interpersonal violence, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	Individuals with bone present	True prevalence rate
Kingston (n = 42)				
Cranium	0	0%	40	0%
Nasal	0	0%	12	0%
Ulna	3	7.14%	38	7.89%
Ribs	2	4.76%	32	6.25%
MC	0	0%	30	0%
Bowling Green Lane (n = 492)				
Cranium	7	1.42%	n/a	n/a
Nasal	16	3.25%	n/a	n/a
Ulna	13	2.64%	n/a	n/a
Ribs	33	6.71%	n/a	n/a
MC	9	1.83%	n/a	n/a
St Benet (n = 162)				
Cranium	0	0%	102	0%
Nasal	0	0%	33	0%
Ulna	2	1.24%	123	1.63%
Ribs	3	1.85%	122	2.46%
MC	2	1.24%	120	1.67%
St Bride (n = 362)				
Cranium	5	1.38%	284	1.76%
Nasal	23	6.35%	153	15.03%
Ulna	3	0.83%	298	1.01%
Ribs	66	18.23%	309	21.36%
MC	11	3.04%	282	3.9%
Cross Bones (n = 45)				
Cranium	0	0%	41	0%
Nasal	2	4.44%	20	10%
Ulna	0	0%	43	0%
Ribs	5	11.11%	43	11.63%
MC	1	2.22%	36	2.78%

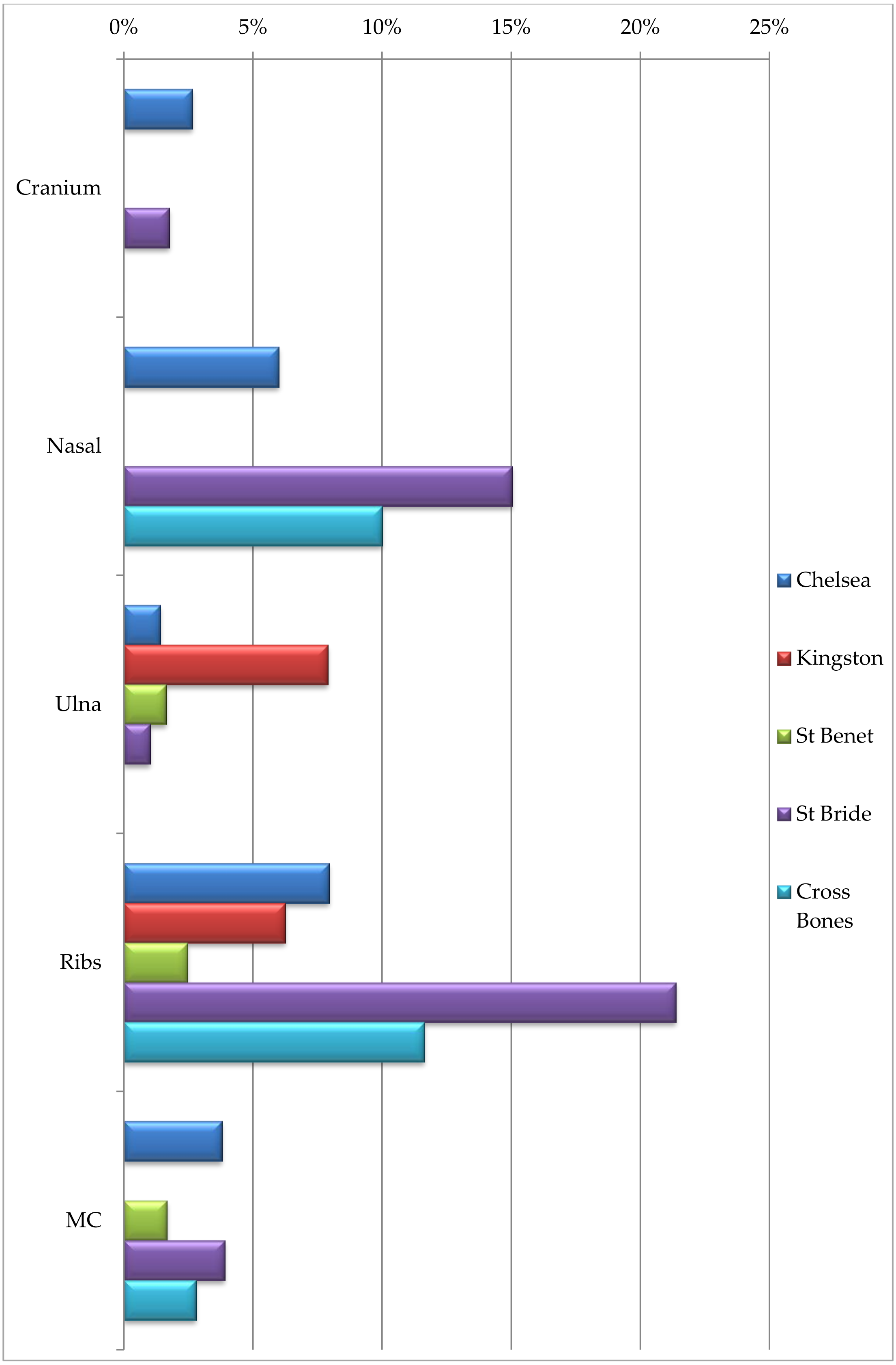


Figure 6.2 - The true prevalence rates for each possible marker of interpersonal violence found in each collection, with the exception of Bowling Green Lane.

The ribs have the highest fracture prevalence rates in every collection with the exception of Kingston where the ulna has the highest rates (7.14% for the crude rate and 7.89% for the true rate) within that particular population. In order to get a better sense of which collection has the highest rate in each possible marker of interpersonal violence when compared to the other collections, the true prevalence rates for each possible marker were inputted into one graph (Figure 6.2). Since Bowling Green Lane only has crude rates, it was omitted from this graph. Graphs depicting the differences seen between the crude and true rates for each collection, with the exception of Bowling Green Lane which only displays the crude rates, are found in section 5.1.1 of Appendix 5.

6.1.2 Chi-squared test results

Similarly to what was seen in section 5.1.2 of Chapter 5, a chi-squared test was run in order to compare all the affected individuals in the collective sample. Bowling Green Lane was omitted once again due to not being able to calculate the number of individuals with the specific bone present and it will be omitted from all statistical tests and ratio calculations seen in this chapter.

The data for each collection was entered into SPSS and the chi-squared test was layered according to the five possible markers of interpersonal violence so that the relationship between the collections for each fracture type could be observed. The results for the collective sample indicate that the differences seen between the collections' fracture prevalence rates are statistically significant ($\chi^2 = 37.772$, df = 4, $p < 0.001$) when observing all five possible markers of interpersonal violence together.

However, when observing the individual possible markers for interpersonal violence, it was permissible to present only one occurrence due to having less than 20% of the expected count being lower than five. The differences seen between the collections when observing the ribs are statistically significant ($\chi^2 = 33.756$, df = 4, $p < 0.001$). These results are acceptable due to only one expected count being lower than five and it equalling 4.35. All other comparisons of the possible markers had 30% or more of their expected counts being lower than five which makes their related statistical results unacceptable (Appendix 5, section 5.1.2).

6.1.3 Odds ratios

Similarly to section 5.1.3 of Chapter 5, odds ratios, using the method described in Field (2009) and summarised in section 3.5.3.1 of Chapter 3, are utilised here. Standardised rate ratios will be calculated when the collective same is further divided according to the sexes and the age categories.

6.1.3.1 Cranium

When observing the depressed cranial fractures, only two collections had this type of fracture, Chelsea and St Bride. As a result, the individuals from Chelsea are 2.5 times more likely to have suffered this type of fracture over the course of their lifetime than if they were from St Bride.

6.1.3.2 Nasal

When the ratios were calculated for the nasal fractures, only three collections were available for comparison. As a result, the individuals from St Bride are three times more likely and those from Cross Bones are 1.83 times more likely to have fractured nasal bones than if they were from Chelsea. Furthermore, the individuals from St Bride are also 1.64 times more likely to have suffered a fractured nasal bone over the course of their lifetime than if they were from Cross Bones.

6.1.3.3 Ulna

Fractures of the ulna were found to be more common in the observed burial grounds; as such, more collections were cross-comparable. However, any comparison which included Cross Bones did not yield a result and is indicated by "n/a" in Table 6.3. Neither Chelsea nor St Bride is more likely than the other to have an individual with a fracture on the ulna. The individuals from Kingston are nine times more likely than those from both Chelsea and St Bride to exhibit this type of fracture, which is the highest ratio seen in the table. Furthermore, the lowest ratio, which is still a rather large difference, indicates that the individuals from St Benet are twice as likely to have suffered a fracture of the ulna during their lifetime as opposed to the individuals exhumed from either Chelsea or St Bride.

Table 6.3 - The odds ratios for fractures of the ulna for pair-wise comparisons seen between the individuals from each collection.

	Odds Ratios	Compared with:
Chelsea	1 : 9	Kingston
Chelsea	1 : 2	St Benet
Chelsea	1	St Bride
Chelsea	n/a	Cross Bones
Kingston	4.5 : 1	St Benet
Kingston	9 : 1	St Bride
Kingston	n/a	Cross Bones
St Benet	2 : 1	St Bride
St Benet	n/a	Cross Bones
St Bride	n/a	Cross Bones

6.1.3.4 Ribs

The chi-squared results were statistically significant for this possible marker of interpersonal violence and individuals affected by such fractures are found in every collection. The highest ratio found in Table 6.4 indicates that the individuals from St Bride are nine times more likely to have this fracture type than if they were from St Benet. On the other hand, the lowest ratio shows that the individuals from Chelsea are 1.29 times more likely to have a fracture on the ribs than those from Kingston.

Table 6.4 - The odds ratios for fractures of the ribs for pair-wise comparisons seen between the individuals of each collection.

	Odds Ratios	Compared with:
Chelsea	1.29 : 1	Kingston
Chelsea	3 : 1	St Benet
Chelsea	1 : 3	St Bride
Chelsea	1: 1.44	Cross Bones
Kingston	2.33 : 1	St Benet
Kingston	1: 3.86	St Bride
Kingston	1 : 1.86	Cross Bones
St Benet	1 : 9	St Bride
St Benet	1 : 4.33	Cross Bones
St Bride	2.08 : 1	Cross Bones

6.1.3.5 Metacarpals

Table 6.5 displays the odds ratios found between the collections when comparing the metacarpal fractures in each skeletal collection. Any comparison featuring Kingston is invalid due to its lack of any individual having a fracture of the metacarpals. As a result, the comparisons with Kingston are indicated by "n/a" in the table. The ratio between Chelsea and St Bride is equivalent to one, which means that neither is more likely than the other to have an individual with this type of fracture. The highest ratio indicates that both the individuals from Chelsea and St Bride are twice as likely to have a fracture of the metacarpals as those from St Benet. The lowest ratio displays that both St Bride and Chelsea are 1.33 times more likely to have an individual with a fractured metacarpal than the Cross Bones burial ground.

Table 6.5 - The odds ratios for metacarpal fractures for pair-wise comparisons seen between the individuals from each collection.

	Odds Ratios	Compared with:
Chelsea	n/a	Kingston
Chelsea	2 : 1	St Benet
Chelsea	1	St Bride
Chelsea	1.33 : 1	Cross Bones
Kingston	n/a	St Benet
Kingston	n/a	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 2	St Bride
St Benet	1 : 1.5	Cross Bones
St Bride	1.33 : 1	Cross Bones

6.2 MALES

6.2.1 Prevalence rates

The calculations found in section 6.1.1 were re-calibrated in order to demonstrate the fracture prevalence rates regarding the fractures commonly associated with interpersonal violence found within the male population. Table 6.6 presents the number of male with a fracture according to each possible marker of interpersonal violence. The ribs have the highest number (n = 88) of males with that particular fracture while males with depressed cranial fractures have the lowest number (n = 14) which is closely followed by fractures of the ulna (n = 15).

Table 6.6 - The number of males with a fracture (N.F) for each possible marker of interpersonal violence.

Bone	N.F
Cranium	14
Nasal	36
Ulna	15
Ribs	88
MC	26

Figure 6.3 displays the crude prevalence rates associated with the collective male sample (n = 719) as well as with the population of males who have suffered a fracture (n = 241). The highest prevalence rates for both the crude (12.24%) and true (36.51%) rates are found within the ribs. The lowest rates, 1.95% (crude) and 5.81% (true) are both associated with the depressed cranial fractures.

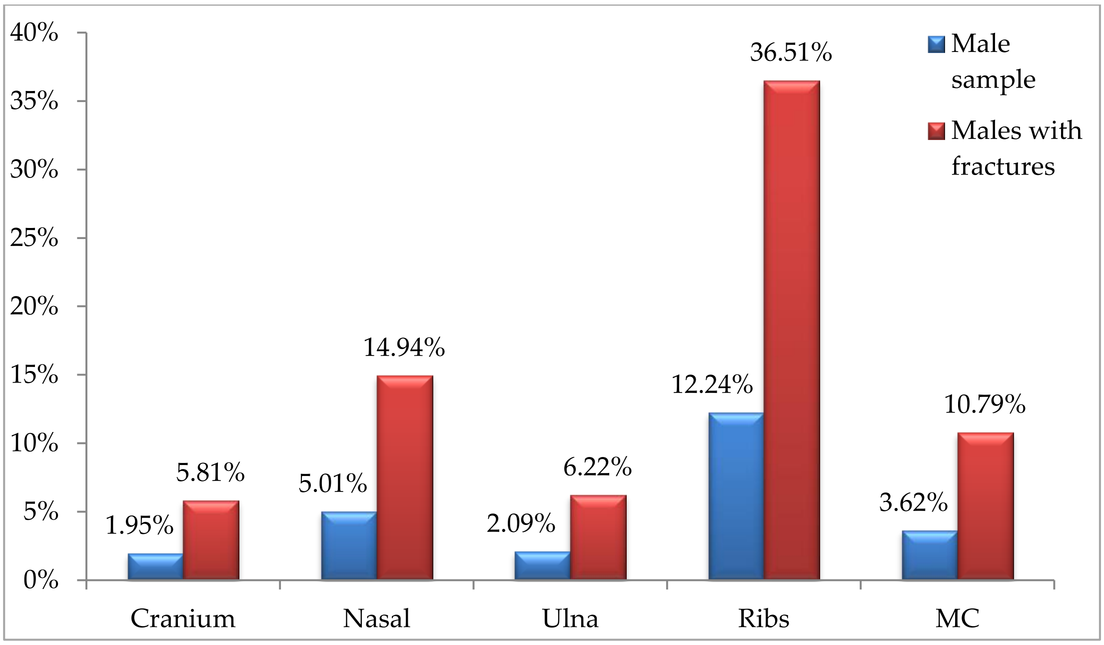


Figure 6.3 - The crude prevalence rates for the possible markers of interpersonal violence for the total male sample (n = 719) and the sample of males with a fracture (n = 241).

Table 6.7 represents the same information as above while being defined by the individual collections. The crude rates are calculated using the total number of males in each collection.

Table 6.7 - The number of males with a fracture (N.F), the number of males with a bone present for each possible marker of interpersonal violence, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	Males with bone present	True prevalence rate
Chelsea (n = 90)				
Cranium	3	3.33%	65	4.62%
Nasal	3	3.33%	30	10%
Ulna	2	2.22%	77	2.6%
Ribs	7	7.78%	73	9.59%
MC	4	4.44%	75	5.33%
Kingston (n = 23)				
Cranium	0	0%	22	0%
Nasal	0	0%	4	0%
Ulna	1	4.35%	20	5%
Ribs	2	8.7%	17	11.77%
MC	0	0%	16	0%
Bowling Green Lane (n = 292)				
Cranium	7	2.4%	n/a	n/a
Nasal	12	4.11%	n/a	n/a
Ulna	11	3.77%	n/a	n/a
Ribs	27	9.25%	n/a	n/a
MC	9	3.08%	n/a	n/a
St Benet (n = 83)				
Cranium	0	0%	61	0%
Nasal	0	0%	20	0%
Ulna	1	1.2%	71	1.41%
Ribs	3	3.61%	74	4.05%
MC	2	2.41%	69	2.9%
St Bride (n = 210)				
Cranium	4	1.91%	176	2.27%
Nasal	19	9.05%	93	20.43%
Ulna	0	0%	174	0%
Ribs	45	21.43%	181	24.86%
MC	10	4.76%	161	6.21%

Table 6.7 cont. - The number of males with a fracture (N.F), the number of males with a bone present for each possible marker of interpersonal violence, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	Males with bone present	True prevalence rate
Cross Bones (n = 21)				
Cranium	0	0%	19	0%
Nasal	2	9.52%	12	16.67%
Ulna	0	0%	21	0%
Ribs	4	19.05%	20	20%
MC	1	4.76%	19	5.26%

The ribs have the highest true rates in all the collections with the exception of Chelsea where its true rate for nasal fractures (10%) is higher than the true rate for the ribs (9.59%). In order to get a better sense of which collection has the highest rate in each possible marker of interpersonal violence compared to the other collections, the true rates for each were inputted into one graph found above (Figure 6.4). Since Bowling Green Lane only has crude rates, it was omitted from the above graph. Graphs for each of the individual collections, comparing the crude and true prevalence rates for each of the fracture types, can be found in section 5.2.1 of Appendix 5.

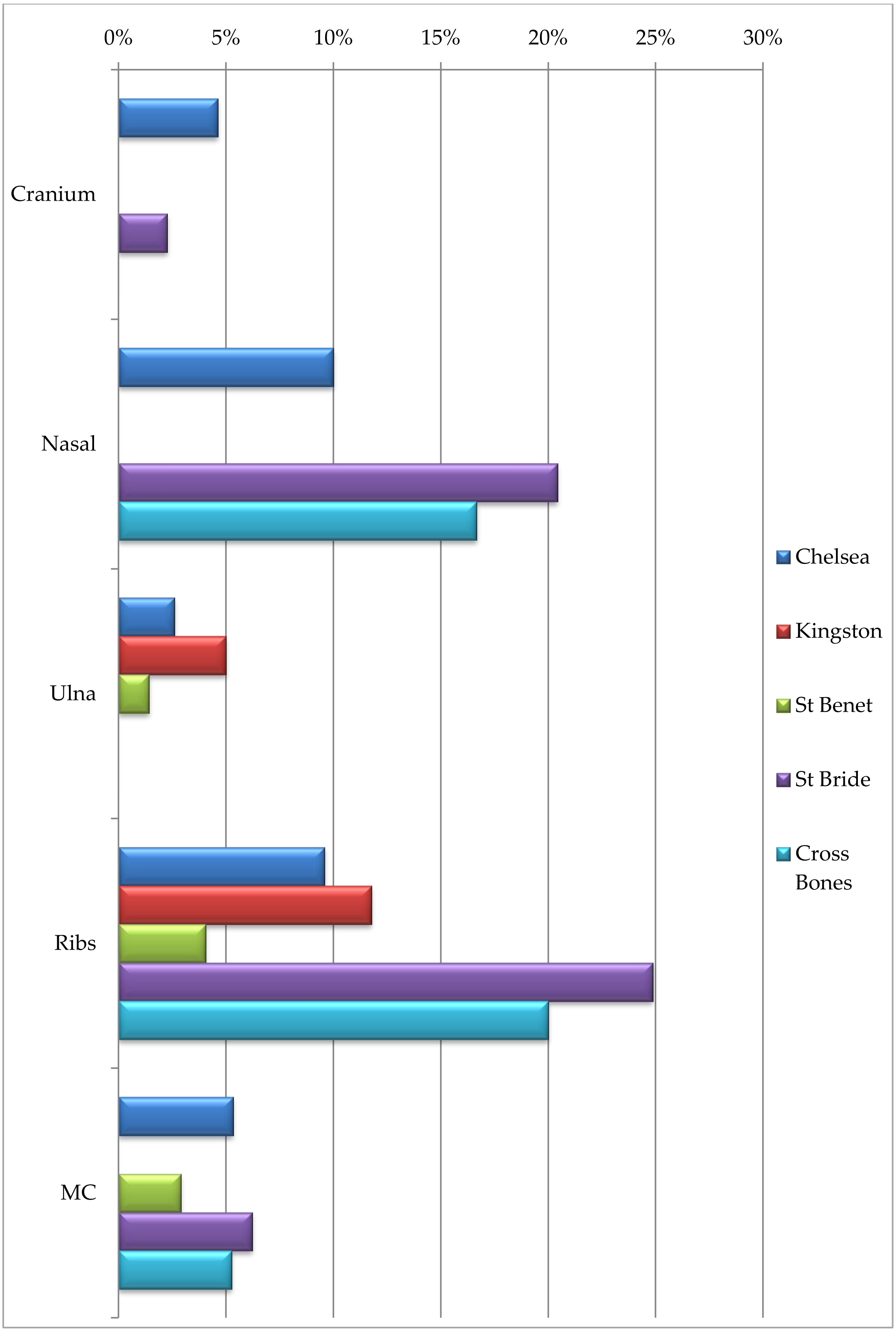


Figure 6.4 - The true prevalence rates for each possible marker of interpersonal violence in each collection for the male sample, with the exception of those from Bowling Green Lane.

6.2.2 Chi-squared test results

The data from both sexes was inputted into one statistical test which was then layered according to each sex in order to be able to examine the differences seen between the collections when looking at the individual possible markers of interpersonal violence. As a result, when observing the data for the males, it was found that the differences seen between the collections when all the possible skeletal markers are included is statistically significant ($\chi^2 = 23.217$, df = 4, $p < 0.001$).

The results can also be observed for every fracture that is more commonly associated with interpersonal violence. Of the five markers, only the result for the ribs was permissible due to 20% of the expected counts being lower than five with a minimum count which equalled 3.13 (Appendix 5, section 5.2.3). The chi-squared test for the ribs is statistically significant ($\chi^2 = 21.279$, df = 4, $p < 0.001$).

6.2.3 Standardised rate ratios

Rather than calculating odds ratios, the method used in this section and in all subsequent sections will be that of the standardised rate ratios laid out in Waldron (1994) and summarised in section 3.5.3.2 of Chapter 3. The ratios can now be standardised since the sample is divided according to sex. As a result, the standardised rate ratios were calculated for every fracture site seen within the male population of every skeletal collection. Since the sample was divided according to sex, age will be the standardising variable throughout these calculations.

6.2.3.1 Cranium

Only the males from Chelsea and St Bride were available for comparison. Chelsea was 2.92 times more likely to have a male with a depressed cranial fracture than those from St Bride. All other comparisons involving the depressed cranial fractures were not possible due to the collections having standard fracture ratios equalling zero.

6.2.3.2 Nasal

When the ratios were calculated for the nasal fractures, only three collections were available for comparison as the others did not have a standard fracture ratio. It was found that St Bride was 1.81 times, and Cross Bones 1.07 times more likely to have males with a nasal fracture than the Chelsea burial ground. Furthermore, the males from St Bride are 1.69 times more likely to have suffered that type of fracture than those from Cross Bones.

6.2.3.3 Ulna

Fractures of the ulna were also only found in three collections for the male population. It was found that Kingston was 1.98 times more likely to have a male with a fracture of the ulna than the males from Chelsea. On the other hand, Chelsea is 1.59 times more likely than the males from St Benet to exhibit that fracture type. Finally, Kingston is 3.15 times more likely than St Benet to have males with a fractured ulna. Any comparisons that included St Bride and Cross Bones were invalid due to each collection having a standard fracture ratio which equalled zero.

6.2.3.4 Ribs

The chi-squared test result for this possible marker of interpersonal violence was found to be statistically significant. When the ratios were calculated for the ribs, all the collections yielded a standard fracture ratio and as a result, comparisons were possible between each of the collections (Figure 6.5). The highest ratio finds that males are 4.86 times more likely to exhibit a rib fracture if they were from the St Bride burial ground rather than if they were from St Benet. The lowest ratio is between Chelsea and Kingston where the males from the former are only 1.14 times more likely to have this type of fracture than if they were from the latter burial ground. A table with the ratios for each pair-wise comparison can be found in section 5.2.4.1 of Appendix 5.

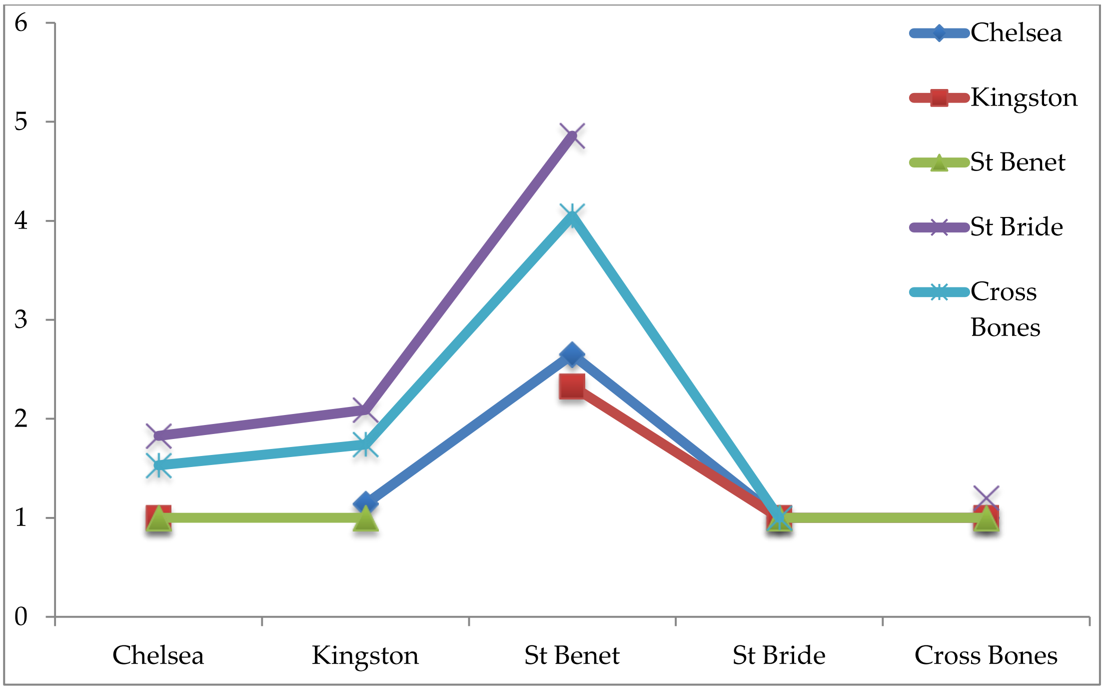


Figure 6.5 - The standardised rate ratios (SRR) for rib fractures for pair-wise comparisons between the males of each collection.

6.2.3.5 Metacarpals

Table 6.8 displays the ratios found between the collections when comparing the metacarpal fractures. All the comparisons where Kingston was included were not possible and are indicated by “n/a” in the table. The highest ratio indicates that the males from Chelsea are 2.03 times more likely to have a metacarpal fracture than those from St Benet, which is not a very high ratio overall. The lowest ratio, between Chelsea and St Bride, finds that the males from the former are only 1.08 times more likely to have this type of fracture than if they were from the latter.

Table 6.8 - The standardised rate ratios (SRR) for metacarpal fractures for pair-wise comparisons between the males from each collection.

	SRR	Compared with:
Chelsea	n/a	Kingston
Chelsea	2.03 : 1	St Benet
Chelsea	1.08 : 1	St Bride
Chelsea	1.29 : 1	Cross Bones
Kingston	n/a	St Benet
Kingston	n/a	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 1.87	St Bride
St Benet	1 : 1.57	Cross Bones
St Bride	1.2 : 1	Cross Bones

6.3 FEMALES

6.3.1 Prevalence rates

The calculations found in section 6.1.1 were re-calibrated in order to demonstrate the prevalence rates for the possible markers of interpersonal violence found within the female population. Table 6.9 presents the number of female individuals within each possible marker of interpersonal violence. The ribs have the highest number (n = 29) of females when looking at the fractures more commonly associated with interpersonal violence while females with depressed cranial fractures have the lowest number (n = 1) with metacarpal fractures being not far behind (n = 2).

Table 6.9 - The number of females with a fracture (N.F) for each possible marker of interpersonal violence.

Bone	N.F
Cranium	1
Nasal	8
Ulna	6
Ribs	29
MC	2

Figure 6.6 displays the crude prevalence rates for the collective female sample (n = 406) as well as for the population of females who have suffered a fracture (n = 88) during their lifetime. The highest prevalence rates are seen in the ribs with 7.14% and 32.96%, respectively, while the lowest rates, 0.25% and 1.14%, respectively, are seen in the depressed cranial fractures.

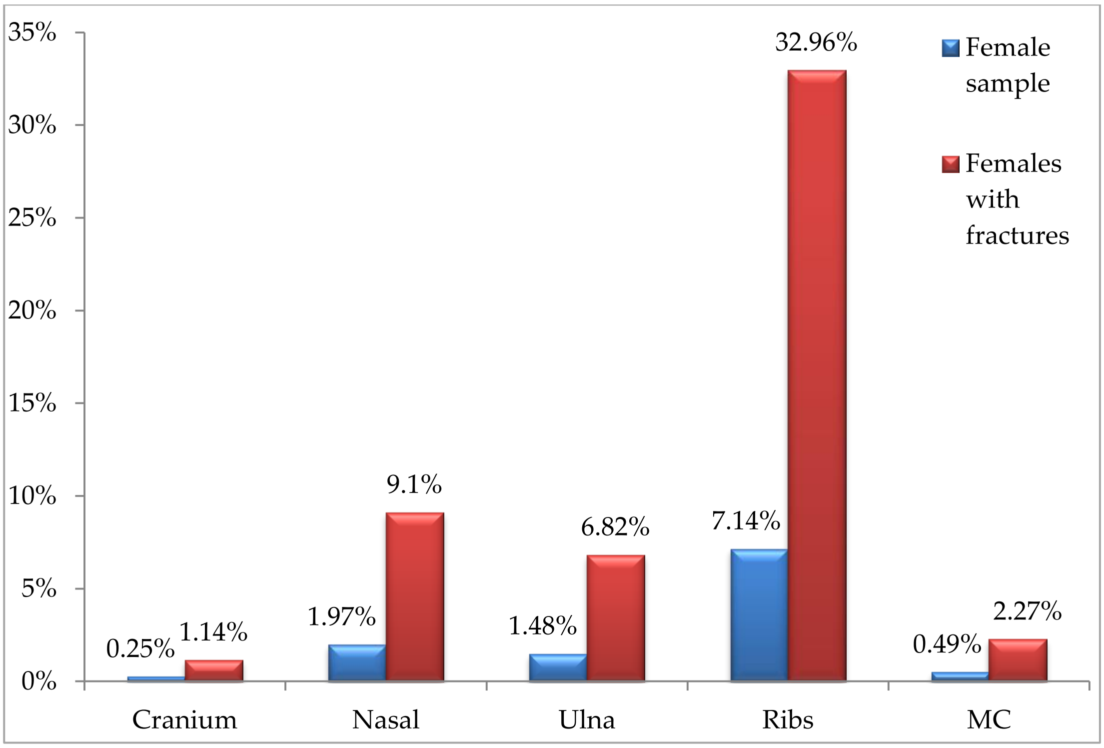


Figure 6.6 - The crude prevalence rates for the possible markers of interpersonal violence for the total female sample (n = 406) and the sample of females with a fracture (n = 88).

Table 6.10 represents the same information as above while being redistributed according to the individual collections. The crude rates are calculated using the total number of females in each collection.

Table 6.10 - The number of females with a fracture (N.F), the number of females with a bone present for each possible marker of interpersonal violence, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	Females with bone present	True prevalence rate
Chelsea (n = 55)				
Cranium	0	0%	35	0%
Nasal	0	0%	17	0%
Ulna	0	0%	50	0%
Ribs	3	5.46%	45	6.67%
MC	1	1.82%	47	2.13%
Kingston (n = 17)				
Cranium	0	0%	16	0%
Nasal	0	0%	8	0%
Ulna	1	5.88%	16	6.25%
Ribs	0	0%	13	0%
MC	0	0%	12	0%
Bowling Green Lane (n = 159)				
Cranium	0	0%	n/a	n/a
Nasal	4	2.52%	n/a	n/a
Ulna	2	1.26%	n/a	n/a
Ribs	6	3.77%	n/a	n/a
MC	0	0%	n/a	n/a
St Benet (n = 39)				
Cranium	0	0%	31	0%
Nasal	0	0%	13	0%
Ulna	1	2.56%	38	2.63%
Ribs	0	0%	36	0%
MC	0	0%	33	0%
St Bride (n = 114)				
Cranium	1	0.88%	94	1.06%
Nasal	4	3.51%	58	6.9%
Ulna	2	1.75%	109	1.84%
Ribs	19	16.67%	107	17.76%
MC	1	0.88%	106	0.94%

Table 6.10 cont. - The number of females with a fracture (N.F), the number of females with a bone present for each possible marker of interpersonal violence, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	Females with bone present	True prevalence rate
Cross Bones (n = 22)				
Cranium	0	0%	22	0%
Nasal	0	0%	8	0%
Ulna	0	0%	22	0%
Ribs	1	4.55%	22	4.55%
MC	0	0%	17	0%

The collections from Chelsea, Bowling Green Lane (crude only), St Bride and Cross Bones all display their highest rates within the ribs. The females from Kingston and St Benet only have fractures in one area, the ulna. St Bride is the only collection with a prevalence rate for each fracture type. In order to get a better sense of which collection has the highest prevalence rate when examining the fractures more commonly associated with interpersonal violence, the true rates for each were inputted into one graph (Figure 6.7). Since Bowling Green Lane only has crude rates, it was omitted from the graph found above. Graphs presenting the crude and true fracture prevalence rates for each possible marker of interpersonal violence according to each individual collection can be found in section 5.2.2 of Appendix 5.

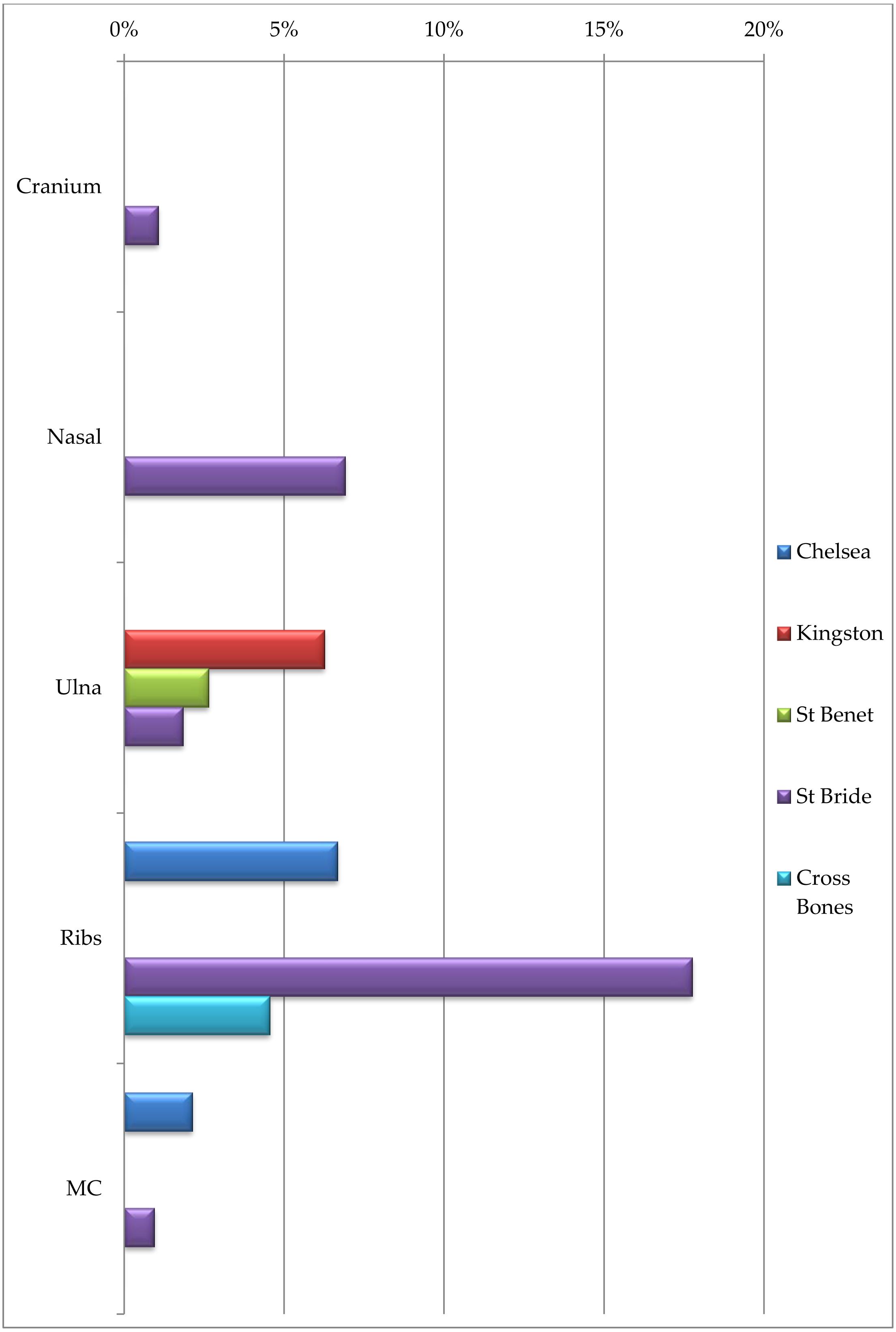


Figure 6.7 - The true prevalence rates for each possible marker of interpersonal violence in each collection for the females in the sample, with the exception of those from Bowling Green Lane.

6.3.2 Chi-squared test results

Using the same chi-squared test as in section 6.2.2, it is possible to examine the differences seen between the females in each collection according to each possible marker of interpersonal violence.

It was found that the differences were statistically significant ($\chi^2 = 14.146$, df = 4, $p = 0.001$) when the markers were observed together. This result is permissible due to 20% of the expected counts being lower than five and the minimum equalling 2.25.

However, none of the results for the individual markers could be presented for the female sample since they all had 40% or more of their expected counts that were lower than five (Appendix 5, section 5.2.3).

6.3.3 Standardised rate ratios

The standardised rate ratios were calculated for every fracture site seen within the female population of every skeletal collection. Since the sample was divided according to sex, age will be the standardising variable throughout these calculations.

6.3.3.1 Cranium

All comparisons for the depressed cranial fractures were invalid due to four out of five standard fracture ratios equalling zero. St Bride had the only calculable standard fracture ratio.

6.3.3.2 Nasal

When the ratios were calculated for the nasal fractures, the same situation as the depressed cranial fractures was found. All comparisons for the nasal fractures were invalid as St Bride once again had the only standard fracture ratio.

6.3.3.3 Ulna

Fractures of the ulna were found in three of the six collections. Any comparison which included Chelsea and Cross Bones were invalid. It was found that the females from Kingston were 1.28 times more likely than those from St Benet and 4.13 times more likely than those from St Bride to suffer a fracture of the ulna during their lifetime. Finally, St Benet is 3.22 times more likely than St Bride to have females with a fractured ulna.

6.3.3.4 Ribs

When the ratios were calculated for the ribs, a standard fracture ratio was also found in three collections. Any comparisons which included Kingston and St Benet were invalid. Chelsea is 1.81 times more likely to have females with rib fractures than the collection from Cross Bones. Furthermore, St Bride is 2.34 times more likely than Chelsea and 4.24 times more likely than Cross Bones to have females with rib fractures.

6.3.3.5 Metacarpals

Metacarpal fractures were only found in the females from Chelsea and St Bride. For this fracture type, it was found that Chelsea is 1.67 times more likely to have a female with a fracture on the metacarpals than those from St Bride. All other comparisons were invalid.

6.4 COMPARISON BETWEEN THE SEXES

6.4.1 Prevalence rates

The true rates for each possible marker of interpersonal violence, according to each sex, were inputted into a graph (Figure 6.8) in order to compare the sexes. The data was taken from Tables 6.6 and 6.9 and excludes the data gathered from Bowling Green Lane.

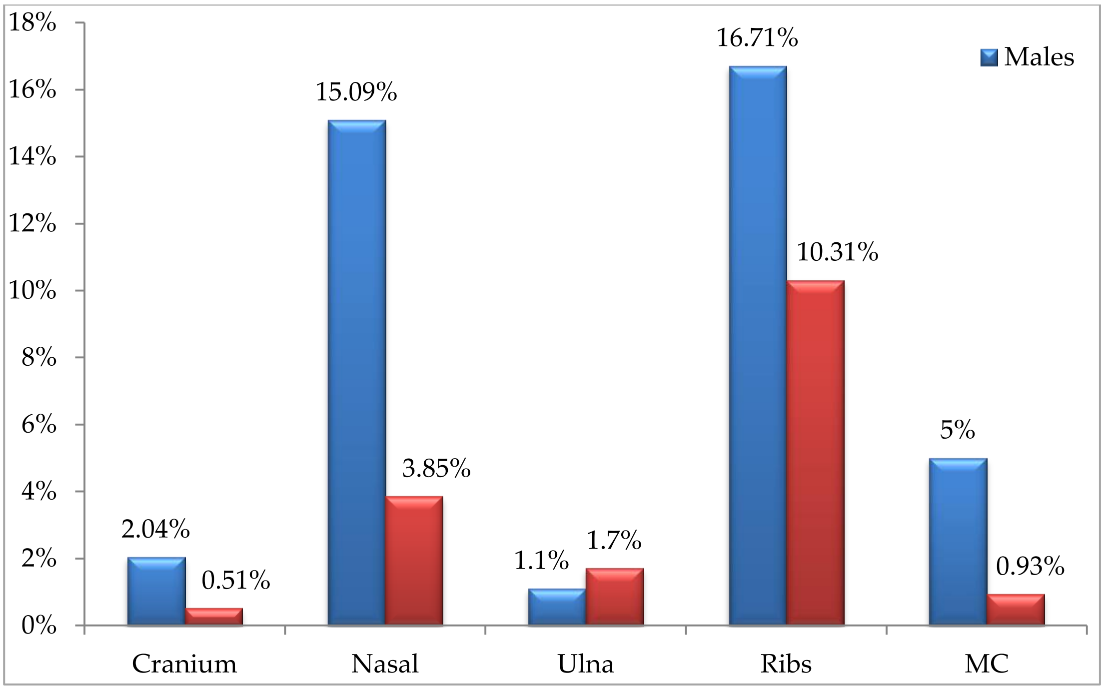


Figure 6.8 - The true prevalence rates for each possible marker of interpersonal violence according to each sex.

The males have higher true prevalence rates in every anatomical location, with the exception of the fractures located on the ulna. The ribs have the highest true rate for both sexes while the lowest true rates are seen in the ulna for the males and in the depressed cranial fractures for the females. Figure 6.9 takes the information found in Figures 6.4 and 6.7 in order to compare the sexes.

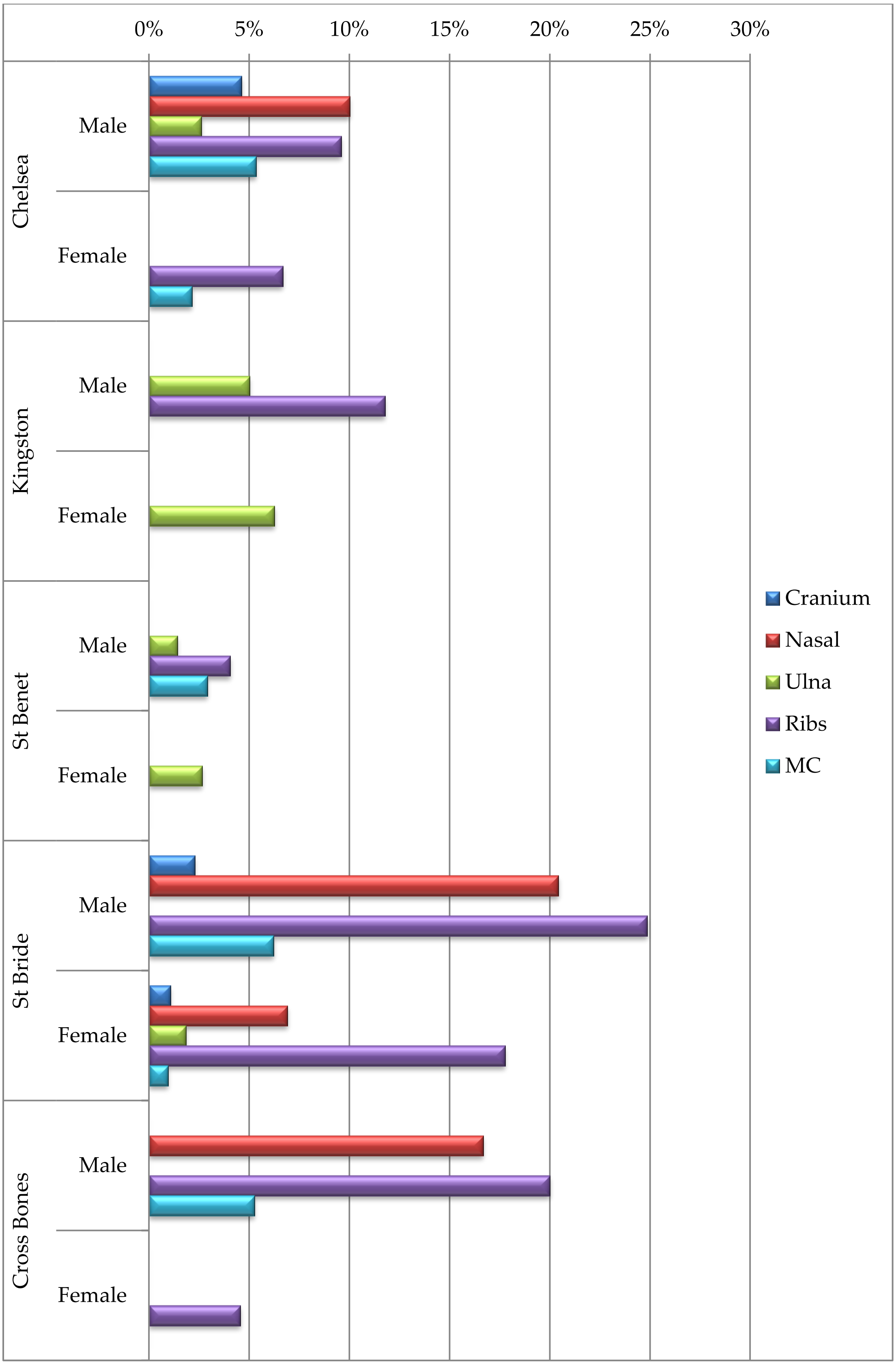


Figure 6.9 - The true prevalence rates for the possible markers of interpersonal violence found in each sex and according to each individual skeletal collection.

6.4.2 Chi-squared test results

Once again the chi-squared test used in sections 6.2.2 and 6.3.2 is able to compare the sexes (Appendix 5, section 5.2.3). The result was found to be statistically significant ($\chi^2 = 34.999$, df = 4, $p < 0.001$) when the possible markers of interpersonal violence were observed collectively.

Furthermore, when observing the individual markers, only the result for the ribs was permissible as all the other possible markers had at least 30% of their expected counts lower than five. As a result, the differences seen between prevalence rates for the males and females when observing the fractures of the ribs, found in each collection, is statistically significant ($\chi^2 = 33.117$, df = 4, $p < 0.001$).

6.4.3 Standardised rate ratios

The standardised rate ratios were calculated for every fracture site to compare the male and female populations. Since the sample was divided according to sex, age will be the standardising variable throughout these calculations.

The males in the sample are 3.61 times more likely to suffer a depressed cranial fracture than the females. The same is seen with nasal fractures where the males are 4.87 times more likely to exhibit that particular fracture type than their female counterparts. The ulnar fractures see a reversal in the above trend as the females are now 1.53 times more likely to have had suffered that specific type of fracture compared to the males in the sample. The rib fractures return to the norm as they are 1.47 times more likely in the male population than in the female population. The ratio found for the rib fractures also happens to be the lowest ratio when comparing the sexes. Lastly, the ratio seen in the comparison for the fractures of the metacarpals is the highest seen between the sexes where the males are 4.9 times more likely to suffer that type of fracture than the females. Therefore, the above results all of the fracture types that are possible markers for interpersonal violence, with the exception of the ulna, support the hypothesis stating that men will have more fractures possibly caused by violence than women (section 3.1.2.2 of Chapter 3). The ratios are illustrated in Figure 6.10 in order to clearly illustrate the differences seen between the sexes.

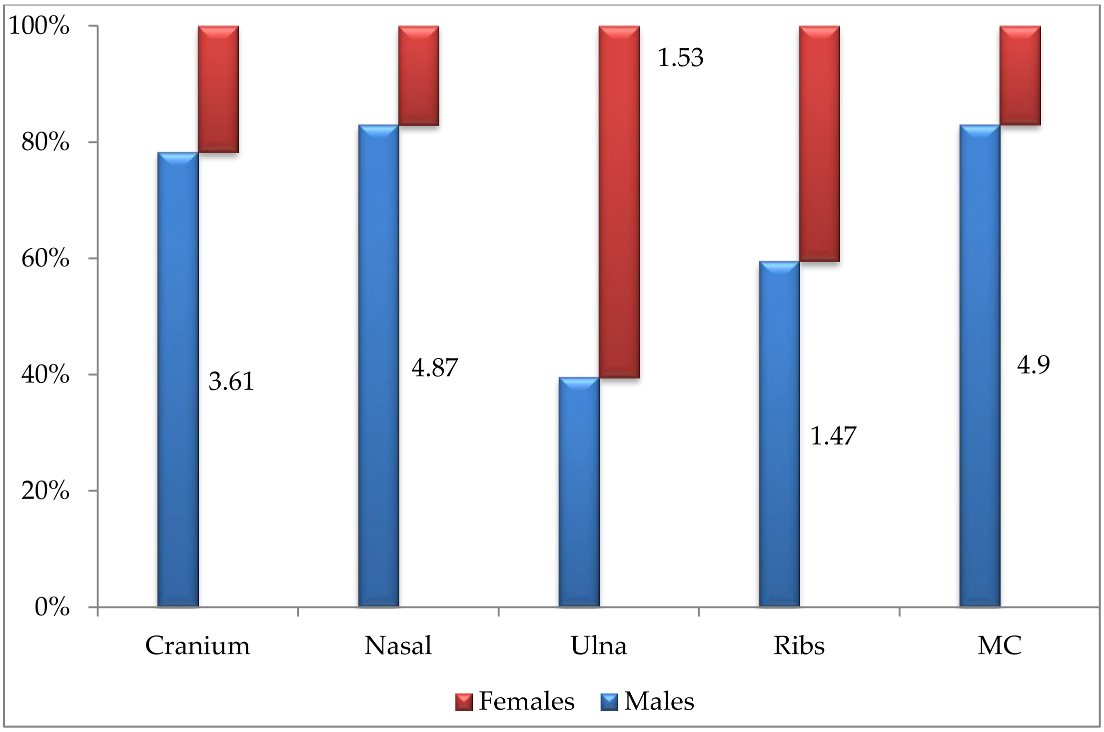


Figure 6.10 - The standardised rate ratios for each possible marker of interpersonal violence when comparing the sexes.

6.5 Young Adults

The individuals from Bowling Green Lane were again omitted from any calculation where the principal delineation is age due to its limitations stated in section 3.3.1.2 of Chapter 3.

6.5.1 Prevalence rates

The calculations found in section 6.1.1 were re-calibrated in order to demonstrate the prevalence rates found within the young adult (YA) population in sample. Table 6.11 presents the numbers of YA displaying each possible marker of interpersonal violence as well as the number of YA with the specific bone present in their respective skeletal inventory. The ribs have the highest number (n = 10) of YA affected while the YA with depressed cranial fractures as well as nasal fractures both have the lowest number (n = 1).

Table 6.11 - The number of YA with a fracture (N.F) for each possible marker of interpersonal violence, as well as the number of YA with each specific bone present.

Bone	N.F	YA with bone present
Cranium	1	153
Nasal	1	70
Ulna	4	189
Ribs	10	179
MC	3	176

As with the male and female sample, two different crude fracture prevalence rates were calculated. The first rate is calculated from the number of YA gathered from the collective sample (n = 197), with the exception of those from BGL. The second rate is focused on the overall number of YA with a fracture (n = 33). Figure 6.11 indicates that the highest crude rates (5.08% and 30.3%, respective of the two samples) are both seen in the ribs for the YA population. The lowest crude rates (0.51% and 3.03%, respectively) are identical for the depressed cranial fractures and the nasal fractures. Additionally, the true rates were included which were calculated using the total number of YA with the bone in question being present found above (Table 6.12). The highest true rate (5.59%) is seen in the ribs while the lowest rate (0.65%) corresponds to the depressed cranial fractures.

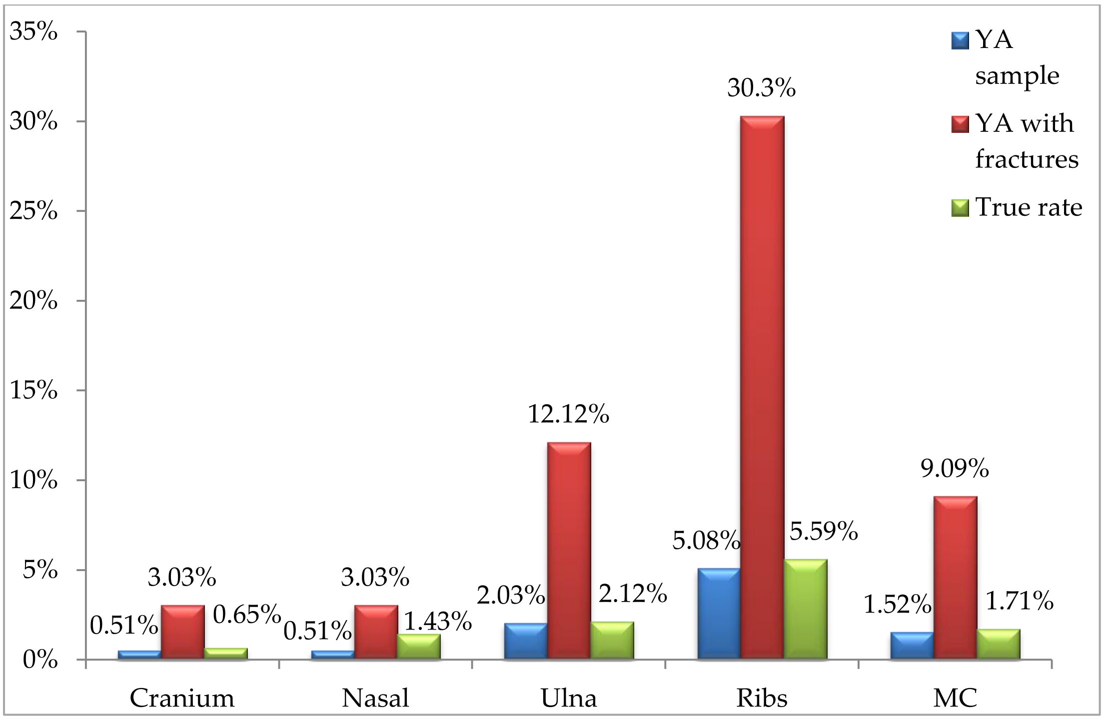


Figure 6.11 - The crude prevalence rates related to the possible markers of interpersonal violence for the total YA sample (n = 197) and the sample of YA with a fracture (n = 33), as well as their respective true prevalence rates.

Table 6.12 represents the same information as above while being presented according to each individual collection. The crude rates in the table are calculated using the total number of YA in each collection. Kingston, St Benet and Cross Bones all only have one possible marker of interpersonal violence that has an observed number and they are the ulna, the metacarpals and the ribs, respectively.

Table 6.12 - The number of YA with a fracture (N.F), the number of YA with a bone present for each possible marker of interpersonal violence, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	YA with bone present	True prevalence rate
Chelsea (n = 48)				
Cranium	1	2.08%	35	2.86%
Nasal	0	0%	15	0%
Ulna	2	4.17%	47	4.26%
Ribs	2	4.17%	38	5.26%
MC	1	2.08%	43	2.33%

Table 6.12 cont. - The number of YA with a fracture (N.F), the number of YA with a bone present for each possible marker of interpersonal violence, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	YA with bone present	True prevalence rate
Kingston (n = 6)				
Cranium	0	0%	6	0%
Nasal	0	0%	4	0%
Ulna	1	16.67%	6	16.67%
Ribs	0	0%	5	0%
MC	0	0%	5	0%
St Benet (n = 56)				
Cranium	0	0%	41	0%
Nasal	0	0%	13	0%
Ulna	0	0%	52	0%
Ribs	0	0%	52	0%
MC	1	1.79%	49	2.04%
St Bride (n = 76)				
Cranium	0	0%	60	0%
Nasal	1	1.32%	33	3.03%
Ulna	1	1.32%	73	1.37%
Ribs	7	9.21%	73	9.59%
MC	1	1.32%	69	1.45%
Cross Bones (n = 11)				
Cranium	0	0%	11	0%
Nasal	0	0%	5	0%
Ulna	0	0%	11	0%
Ribs	1	9.09%	11	9.09%
MC	0	0%	10	0%

The ribs have the highest fracture prevalence rates in every collection where rib fractures are present (i.e. Chelsea, St Bride and Cross Bones) within the YA population. Kingston and St Benet do not have any YA with rib fractures and as a result, the ulna (16.67%) and metacarpals (2.04%) are their highest true rates, respectively. Kingston's ulna fracture rate (16.67%) is the highest crude and true rate found in all the fracture types. In order to get a better sense of which collection has the highest prevalence rate when observing the possible markers of interpersonal violence, the true rates for each were inputted into one graph (Figure 6.12). Graphs for each individual collection illustrating the comparison of the crude and true prevalence rates for each of the fracture types can be found in section 5.3.1 of Appendix 5.

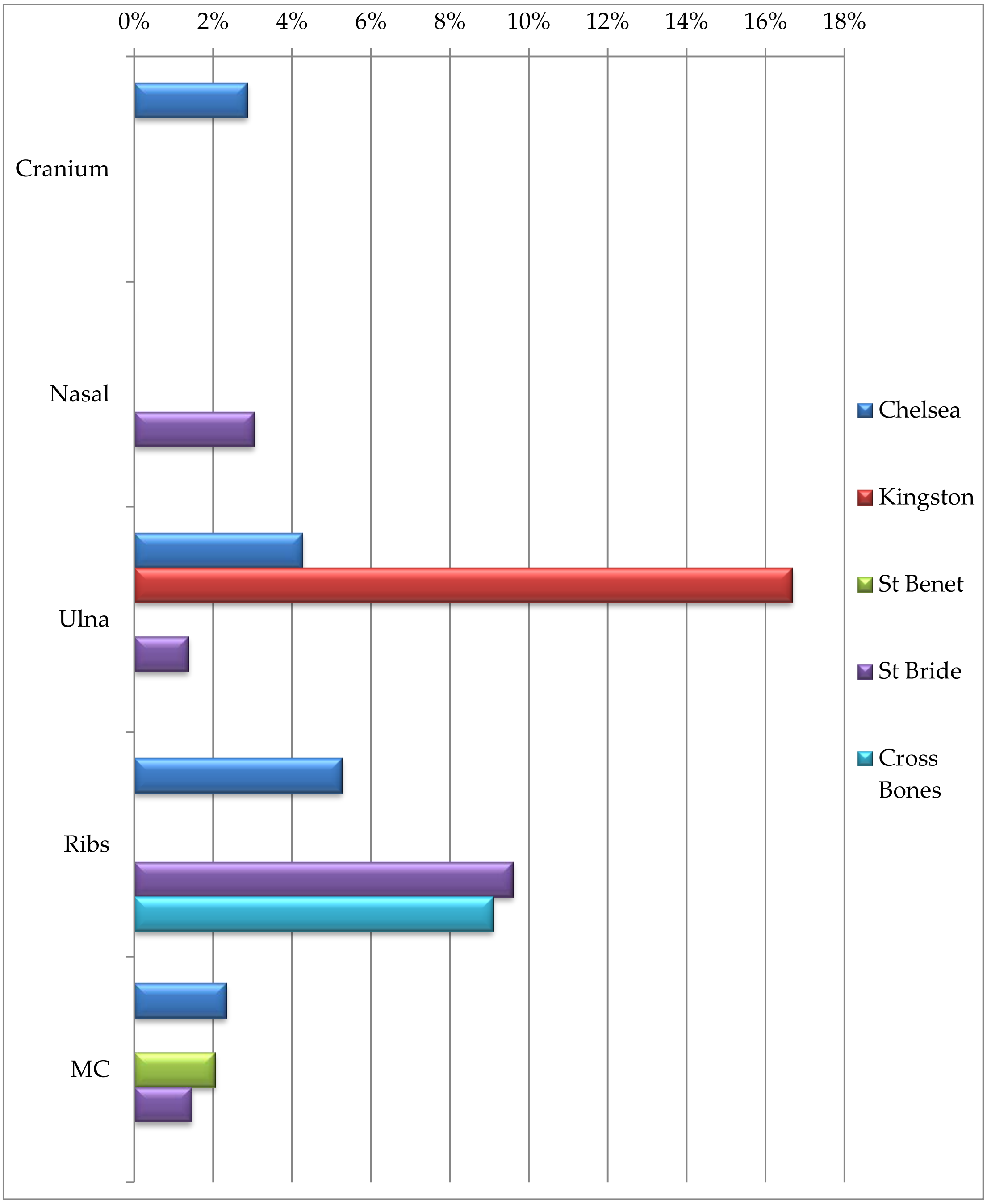


Figure 6.12 - The true prevalence rates for each possible marker associated with interpersonal violence in each collection for the YA in the sample.

6.5.2 Chi-squared test results

Correspondingly to how the data was entered into one test for both sexes, the procedure was followed when analysing the age categories. The relationships were observed between the collections, according to each fracture site that is more commonly associated with interpersonal violence, and layered in the chi-squared test according to each age category.

When observing the YA, the outcome differs from any seen in the previous statistical test results found in the current project. The statistical test is not presentable due to 30% of the expected counts being lower than five and the lowest expected count equalling 0.64, which is lower than the minimum value of one (Appendix 5, section 5.3.4). An answer to this problem is to add more data to augment the expected counts or change the data's categorisation. Since it is not possible to add YA individuals to the sample, and changing the data categorisation would affect the outcome of the other two age categories which are all included in one test, the data was not changed.

6.5.3 Standardised rate ratios

Since the sample was divided according to age, sex will be the standardising variable throughout the following calculations.

6.5.3.1 Cranium

All comparisons for the depressed cranial fractures were invalid as Chelsea is the only collection with a standard fracture ratio for this fracture type.

6.5.3.2 Nasal

When the ratios were calculated for the nasal fractures, the same situation as the depressed cranial fractures was found. All comparisons for the nasal fractures were invalid due to four out of five standard fracture ratios equalling zero. The only standard fracture ratio was found within the collection from St Bride.

6.5.3.3 Ulna

Fractures of the ulna were found in two collections. It was found that Chelsea was 3.09 times more likely to have a YA with a fracture of the ulna than those from St Bride. All other comparisons between the remaining skeletal collections were invalid due to their standard fracture ratio being zero.

6.5.3.4 Ribs

When the ratios were calculated for the ribs, three collections generated a standard fracture ratio. As a result, the YA are 1.82 times more likely to have a fracture located on the ribs if they were from St Bride rather than Chelsea. Furthermore, those from Cross Bones are 1.9 times more likely than the YA from Chelsea and only 1.05 times more likely than those from St Bride to have this type of fracture.

6.5.3.5 Metacarpals

Similarly to what was seen with the ribs, the metacarpal fractures yielded three collections with a standard fracture ratio. Chelsea is only 1.08 times more likely than St Benet and 1.57 times more likely than St Bride to have a YA with metacarpal fractures. Furthermore, St Benet is 1.46 times more likely to have a YA with a fractured metacarpal than those from St Bride. All other comparisons involving Kingston and Cross Bones were invalid.

6.6 MIDDLE ADULTS

6.6.1 Prevalence rates

The calculations found in section 6.1.1 were re-calibrated in order to demonstrate the prevalence rates found within the middle adult (MA) population. Table 6.13 presents the number of MA exhibiting each possible marker of interpersonal violence as well as the total number of MA with the particular bone present within their skeletal inventory. The ribs have the highest number (n = 30) of MA exhibiting a fracture while the MA with depressed cranial fractures as well as those with fractures of the ulna have the lowest number (n = 3).

Table 6.13 - The number of MA with a fracture (N.F) for each possible marker of interpersonal violence, as well as the number of MA with the specific bone present.

Bone	N.F	MA with bone present
Cranium	3	175
Nasal	14	94
Ulna	3	210
Ribs	30	201
MC	7	193

Figure 6.13 presents the two crude prevalence rates which were calculated using the collective MA sample (n = 226) and the MA sample with fractures (n = 68). The true fracture rates are also included and are calculated using the number of affected MA for every possible marker of interpersonal violence seen in Table 6.13. The ribs are the fracture type with the highest crude rates, 13.27% and 44.12%, respectively. The highest true rate seen in the MA population is also found in the ribs with 14.93%, the nasal fractures are not far behind with a true fracture prevalence rate of 14.89%. The nasal fractures have the biggest difference between the crude (collective MA sample) and true rates, a discrepancy of 8.64%. The depressed cranial fractures and ulnar fractures share

the lowest crude rates (1.33%, for the collective sample and 4.41%, for the sample with fractures) while the lowest true rate (1.43%) is only associated with fractures of the ulna.

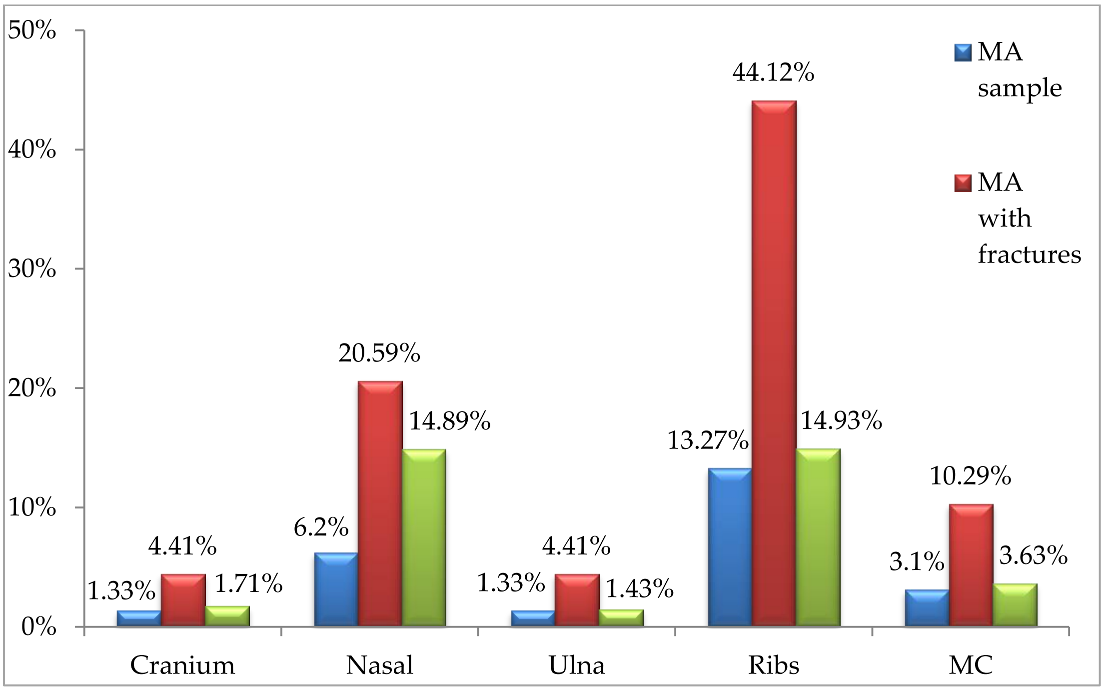


Figure 6.13 - The crude prevalence rates related to the possible markers of interpersonal violence for the total MA sample (n = 226) and the sample of MA with a fracture (n = 68), as well as their respective true prevalence rates.

Table 6.14 represents the same information as above while being divvied according to each individual collection. The crude rates in the table are calculated using the total number of MA from each collection. The ribs are present in every collection and also have the highest number of affected MA in each circumstance. However, when observing the MA from St Benet, it is seen that the fractures of the ulna have an affected number of individuals that is identical to that of the ribs for this particular collection.

Table 6.14 - The number of MA with a fracture (N.F), the number of MA with a bone present for each possible marker of interpersonal violence, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	MA with bone present	True prevalence rate
Chelsea (n = 41)				
Cranium	2	4.88%	25	8%
Nasal	2	4.88%	12	16.67%
Ulna	0	0%	36	0%
Ribs	4	9.76%	35	11.43%
MC	1	2.44%	31	3.23%
Kingston (n = 10)				
Cranium	0	0%	10	0%
Nasal	0	0%	3	0%
Ulna	0	0%	9	0%
Ribs	1	10%	8	12.5%
MC	0	0%	6	0%
St Benet (n = 38)				
Cranium	0	0%	29	0%
Nasal	0	0%	10	0%
Ulna	2	5.26%	36	5.56%
Ribs	2	5.26%	33	6.06%
MC	1	2.63%	33	3.03%
St Bride (n = 118)				
Cranium	1	0.85%	96	1.04%
Nasal	10	8.48%	57	17.54%
Ulna	1	0.85%	113	0.89%
Ribs	19	16.1%	108	17.59%
MC	4	3.39%	108	3.7%
Cross Bones (n = 17)				
Cranium	0	0%	15	0%
Nasal	2	11.76%	12	16.67%
Ulna	0	0%	16	0%
Ribs	4	23.53%	17	23.53%
MC	1	5.88%	15	6.67%

The ribs have the highest true fracture prevalence rates in every collection when observing the MA population, with one exception; the nasal fractures in Chelsea have the highest true rate (16.67%) for this particular burial ground. Also, the nasal fractures (17.54%) in St Bride are a very close second to the ribs' higher true prevalence rate of 17.59%.

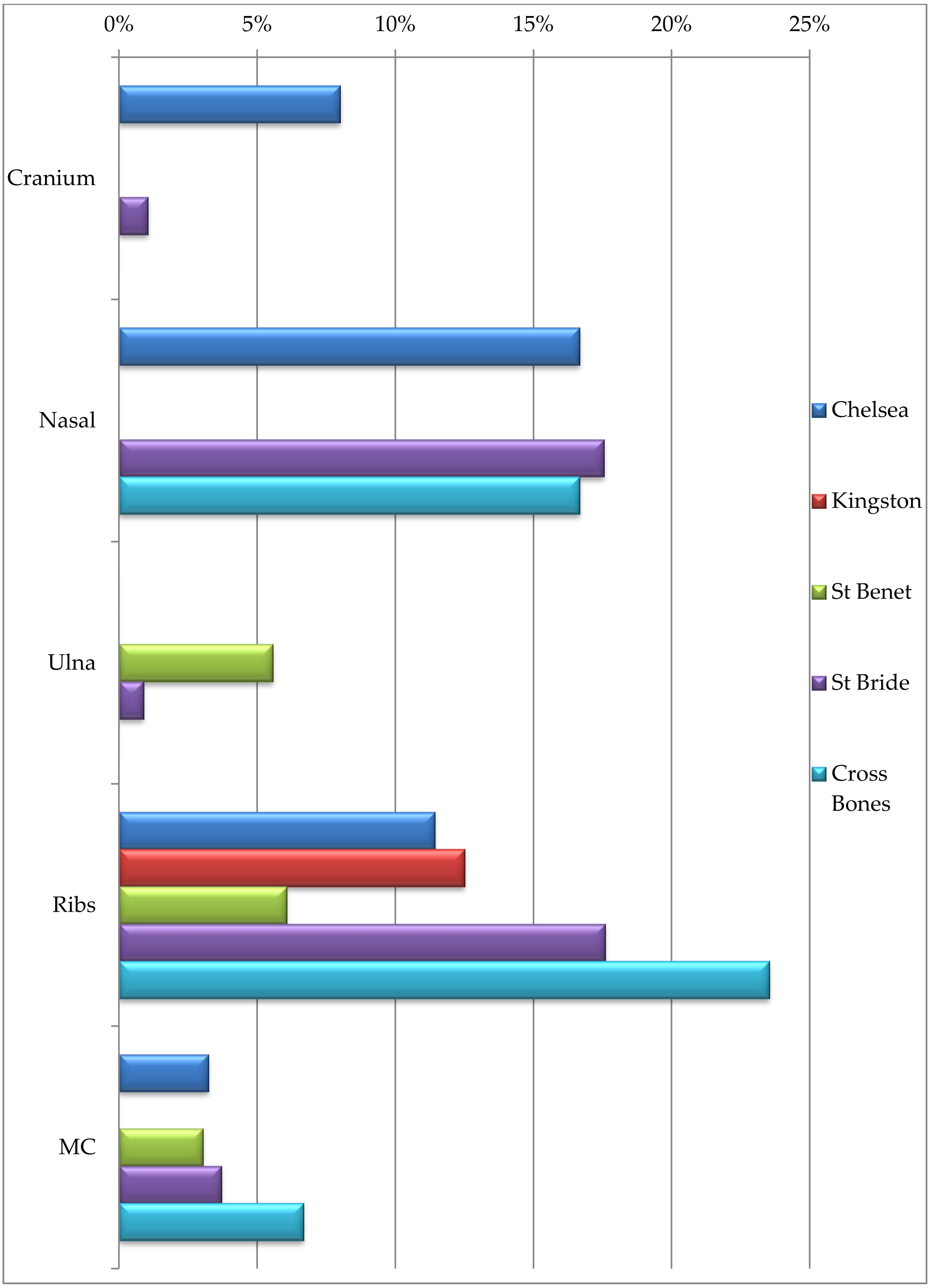


Figure 6.14 - The true prevalence rates for each possible marker of interpersonal violence in each collection for the MA sample.

In order to get a better sense of which collection has the highest prevalence rate in each fracture site more commonly associated with interpersonal violence, the true rates for each were imputed into the graph found above (Figure 6.14). Graphs for each individual collection, presenting the crude and true fracture prevalence rates for each fracture type, can be found in section 5.3.2 in Appendix 5.

6.6.2 Chi-squared test results

When observing the data presented by the MA population, the chi-squared test used in the aforementioned section 6.5.2, reveals that the differences seen between the collections are statistically significant ($\chi^2 = 4.277$, df = 4, $p = 0.025$) when all the possible markers of interpersonal violence are analysed together. However, when the possible markers were analysed separately, the results were not presentable as they all had 30% or more of their expected counts being less than five (Appendix 5, section 5.3.4).

6.6.3 Standardised Rate Ratios

The standardised rate ratios were calculated for every fracture site seen within the MA population of every skeletal collection even though the statistical results were not presentable for the individual fractures that are more commonly associated with interpersonal violence. Since the sample was divided according to age, sex will be the standardising variable throughout these calculations.

6.6.3.1 Cranium

All comparisons for the depressed cranial fractures were invalid other than the one between Chelsea and St Bride. The MA from Chelsea are 8.27 times more likely to have an individual with a depressed cranial fracture than those from St Bride.

6.6.3.2 Nasal

When the ratios were calculated for the nasal fractures, three collections were comparable. It was found that the MA were only 1.12 times more likely to have suffered a fracture of the nasal bones if they were from Chelsea as opposed to St Bride. Furthermore, the MA from Chelsea were also 1.31 times more likely than those from Cross Bones to exhibit this fracture type. Finally, the MA from St Bride were 1.17 times more likely to have a fracture of the nasal bones than those from Cross Bones. Any comparisons which included Kingston and St Benet were invalid due to their lack of a standard fracture ratio.

6.6.3.3 Ulna

Fractures of the ulna were found in two collections. It was found that the MA from St Benet were 12.95 times more likely to have a fracture of the ulna than those from St Bride. This is the highest ratio for any comparison that can be found in this chapter as well as the two previous Results chapters. All other comparisons between the remaining skeletal collections were invalid due to unavailable standard fracture ratios.

6.6.3.4 Ribs

When the ratios were calculated for the ribs, all the collections yielded a standard fracture ratio and as a result, comparisons were possible between each of the collections (Figure 6.15). The highest ratio indicates that the MA from Cross Bones are 4.58 times more likely to have suffered a fracture of the ribs over the course of their lifetime than if they were from St Benet. The lowest ratio finds that the MA from Kingston are only 1.08 times more likely to have this type of fracture than those from Chelsea. The standardised rate ratios for every comparison can be found in section 5.3.5.1 of Appendix 5.

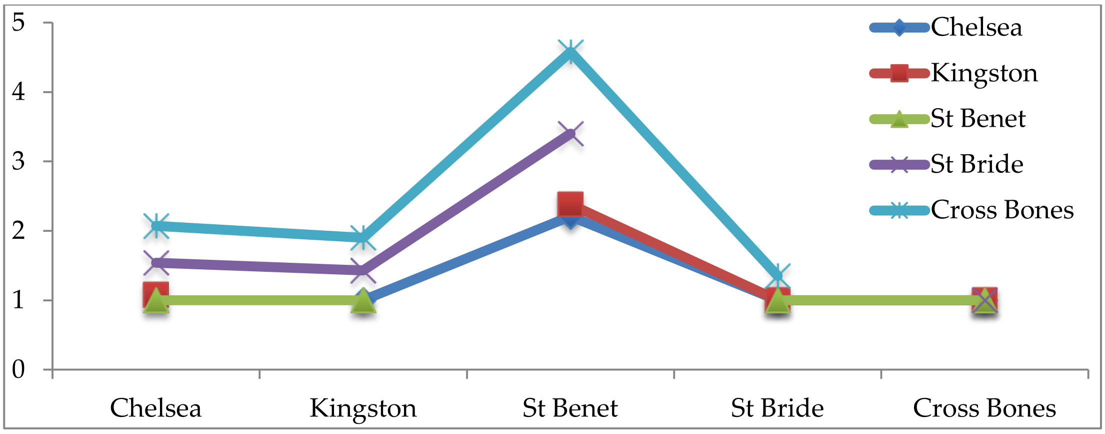


Figure 6.15 - The standardised rate ratios (SRR) for rib fractures for pair-wise comparisons between the MA of each collection.

6.6.3.5 Metacarpals

Table 6.15 displays the ratios found between the collections when comparing the metacarpal fractures. All the comparisons where Kingston was included stemmed invalid results and are indicated by "n/a" in the table. The highest ratio is found between St Benet and Cross Bones where the MA from the latter are 3.12 times more likely to have this type of fracture than those from the former. The lowest ratio, which barely demonstrates a difference between the two burial grounds, indicates that the MA from St Bride are only 1.01 times more likely than those from Chelsea to have a fracture of the metacarpals.

Table 6.15 - Standardised rate ratios (SRR) for metacarpal fractures for pair-wise comparisons between the MA of each collection.

	SRR	Compared with:
Chelsea	n/a	Kingston
Chelsea	1.84 : 1	St Benet
Chelsea	1 : 1.01	St Bride
Chelsea	1 : 1.7	Cross Bones
Kingston	n/a	St Benet
Kingston	n/a	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 1.86	St Bride
St Benet	1 : 3.12	Cross Bones
St Bride	1 : 1.68	Cross Bones

6.7 OLD ADULTS

6.7.1 Prevalence rates

The calculations found in section 6.1.1 were re-calibrated in order to demonstrate the prevalence rates found within the old adult (OA) population in the sample. Table 6.16 presents the number of OA exhibiting a fracture within each possible marker of interpersonal violence as well as the total number of OA with the specific bone present. The ribs have the highest number (n = 36) of affected OA while the OA with fractures of the ulna have the lowest number (n = 2) followed closely behind by the OA with depressed cranial fractures (n = 3).

Table 6.16 - The number of OA with a fracture (N.F) for each marker of interpersonal violence, as well as the number of OA with the specific bone present.

Bone	N.F	OA with bone present
Cranium	3	133
Nasal	11	66
Ulna	2	155
Ribs	36	151
MC	8	147

Figure 6.16 presents the two crude prevalence rates which were calculated using the collective OA sample (n = 168) and the OA sample with fractures (n = 77). The true fracture prevalence rates are also presented and are calculated using the information found in Table 6.18. The highest crude rates (21.43% and 46.75%, respective of the aforementioned samples) are seen in the ribs for the OA populations while the lowest crude rates (1.19% and 2.6%, respectively) are seen in the fractures of the ulna. As for the true rates, the highest (23.84%) is also found in the ribs while the lowest (1.29%) is once again associated with the ulna. The crude rate for the nasal fractures (14.29%) calculated from the OA with fractures (n = 77) is lower than the true rate

(16.67%) for the same possible marker of interpersonal violence, which is the only such occurrence.

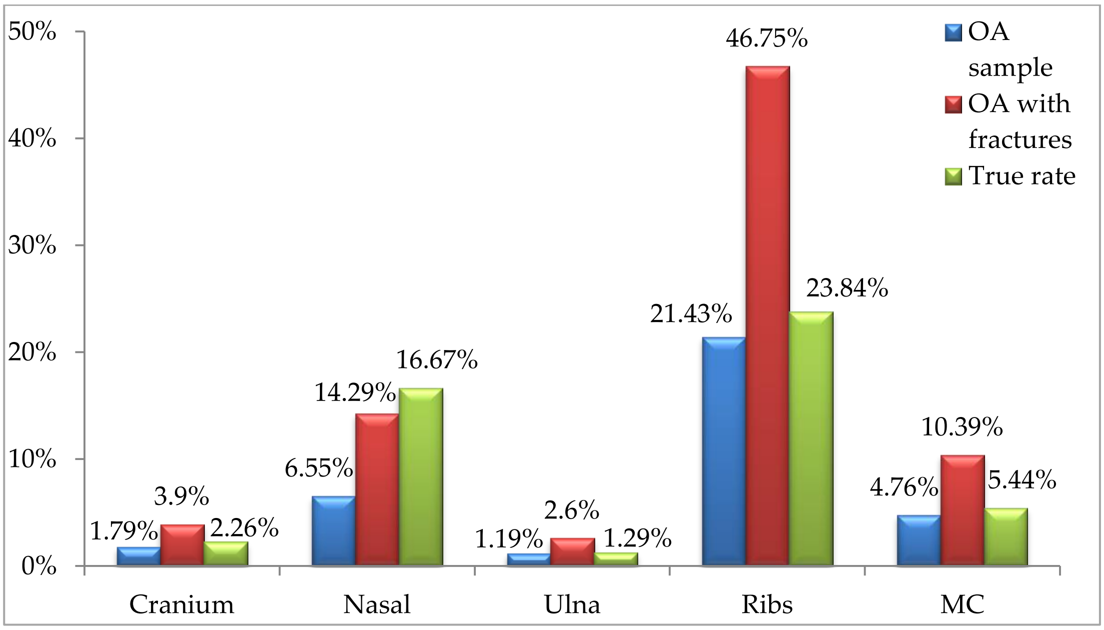


Figure 6.16 - The crude prevalence rates related to the possible markers of interpersonal violence for the total OA sample (n = 168) and the sample of OA with a fracture (n = 77), as well as their respective true prevalence rates.

Table 6.17 represents the same information as above while being delineated by the individual collections. The presented crude prevalence rates were calculated using the number of OA found in each collection. Cross Bones is the only collection which displays an observed rate of zero for every marker of interpersonal violence in the OA sample.

Table 6.17 - The number of OA with a fracture (N.F), the number of OA with a bone present for each possible marker of interpersonal violence, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	OA with bone present	True prevalence rate
Chelsea (n = 43)				
Cranium	0	0%	28	0%
Nasal	1	2.33%	17	5.88%
Ulna	0	0%	39	0%
Ribs	4	9.3%	35	11.43%
MC	3	6.98%	42	7.14%

Table 6.17 cont. - The number of OA with a fracture (N.F), the number of OA with a bone present for each possible marker of interpersonal violence, as well as their respective crude and true prevalence rates, according to each skeletal collection.

Bone	N.F	Crude prevalence rate	OA with bone present	True prevalence rate
Kingston (n = 18)				
Cranium	0	0%	17	0%
Nasal	0	0%	5	0%
Ulna	2	11.11%	17	11.77%
Ribs	1	5.56%	17	5.88%
MC	0	0%	13	0%
St Benet (n = 18)				
Cranium	0	0%	11	0%
Nasal	0	0%	6	0%
Ulna	0	0%	16	0%
Ribs	1	5.56%	17	5.88%
MC	0	0%	15	0%
St Bride (n = 75)				
Cranium	3	4%	63	4.76%
Nasal	10	13.33%	36	27.78%
Ulna	0	0%	69	0%
Ribs	30	40%	68	44.12%
MC	5	6.67%	68	7.35%
Cross Bones (n = 14)				
Cranium	0	0%	14	0%
Nasal	0	0%	2	0%
Ulna	0	0%	14	0%
Ribs	0	0%	14	0%
MC	0	0%	9	0%

The ribs have the highest crude and true fracture prevalence rates in every collection where rib fractures are present within the OA population. The exception is Kingston as the ulnar fractures have the highest crude (11.11%) and true (11.77%) rates. In order to get a better sense of which collection has the highest prevalence rate in each fracture more commonly associated with interpersonal violence compared to the other collections, the true rates for each were inputted into one graph (Figure 6.17). Even though none of the OA from Cross Bones presented a fracture that is more commonly associated with interpersonal violence, the collection was included in this figure to demonstrate its lack of prevalence rates in the OA population. Graphs depicting the comparisons of the crude and true fracture prevalence rates representing the fracture types, for every collection other than Cross Bones, can be found in section 5.3.3 of Appendix 5.

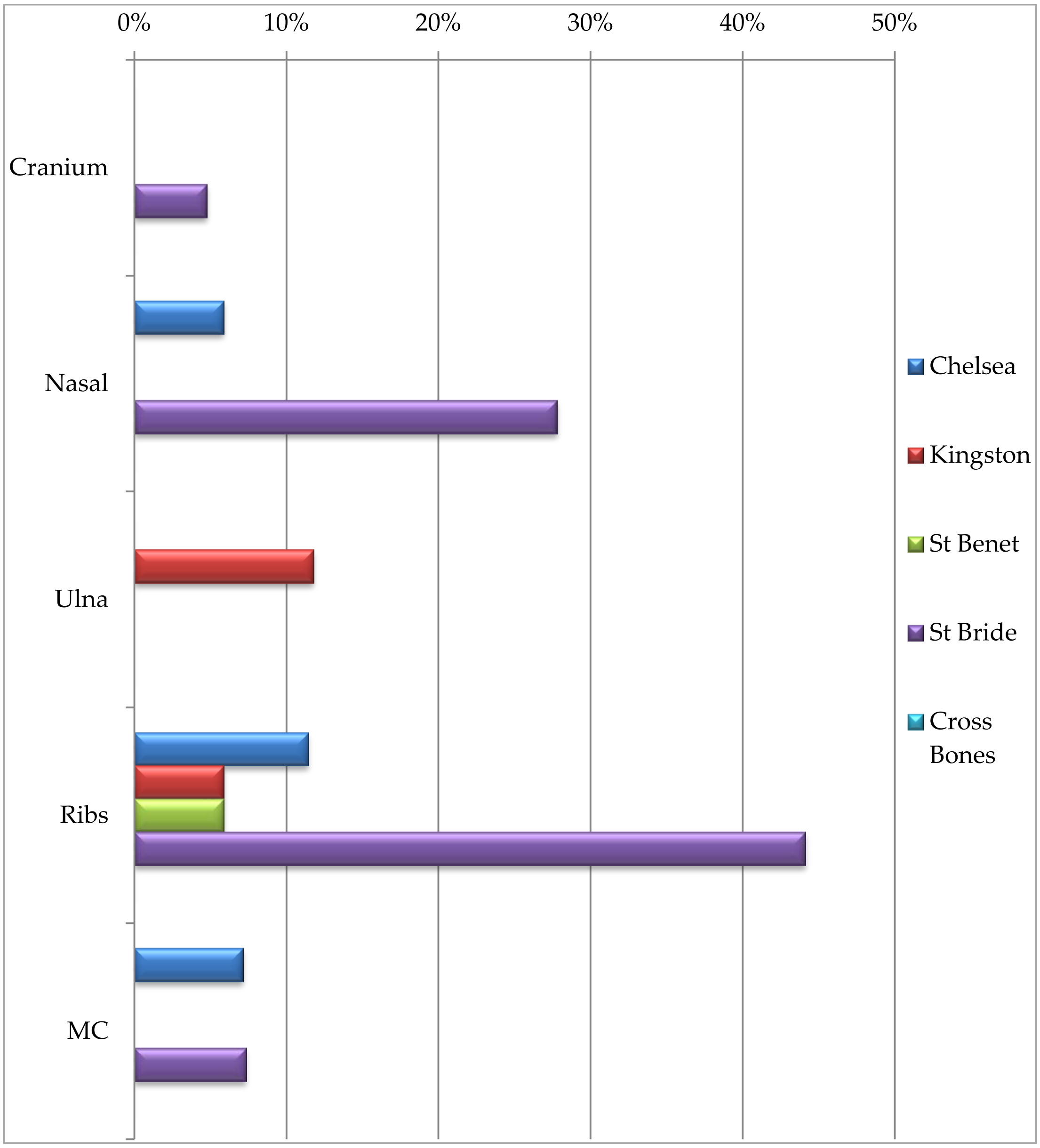


Figure 6.17 - The true prevalence rates for each possible marker of interpersonal violence in each collection for the OA in the sample.

6.7.2 Chi-squared test results

Using the statistical test which presented the results for the YA and the MA, the data for the OA revealed that the differences seen between the collections are statistically significant ($\chi^2 = 30.509$, df = 4, $p < 0.001$) when all the possible markers of interpersonal violence were analysed together. When the possible markers were analysed separately, the results were not presentable as they all had 30% or more of their expected counts being less than five (Appendix 5, section 5.3.4).

6.7.3 Standardised rate ratios

The standardised rate ratios were calculated for every fracture site seen within the OA population of every skeletal collection. Since the sample was divided according to age, sex will be the standardising variable for the following calculations.

6.7.3.1 Cranium

All comparisons for the depressed cranial fractures were invalid due to St Bride being the only collection with a standard fracture ratio.

6.7.3.2 Nasal

When the ratios were calculated for the nasal fractures, two collections were comparable. In this case, the OA were 5.87 times more likely to have a fracture on the nasal bones if they were from St Bride rather than Chelsea. All other comparisons were invalid due to not being able to calculate a standard fracture ratio.

6.7.3.3 Ulna

Fractures of the ulna were only found in one collection which hinders the possibility of any comparisons between the collections. The standard fracture ratio was calculable for Kingston while for all the other collections, it equalled zero.

6.7.3.4 Ribs

When the ratios were calculated for the ribs, all the collections yielded a standard fracture ratio, with the exception of Cross Bones, which makes any comparison with this collection invalid and is thusly indicated by "n/a" in Table 6.18. The OA have the same odds whether they are from Kingston or St Benet when observing the presence of fractures on the ribs. The highest ratio indicates that the OA are 6.64 times more likely to have a fracture on the ribs if they are from the St Bride burial ground rather than the one from Kingston. Following very closely behind, St Bride is also 6.61 times more likely than St Benet to have an OA with this type of fracture. The lowest ratios indicate the OA from Chelsea are 2.39 times more likely than those from Kingston and 2.38 times more likely than those from St Benet to have suffered a fracture on the ribs during their lifetime.

Table 6.18 - The standardised rate ratios (SRR) for rib fractures for pair-wise comparisons between the OA of each collection.

	SRR	Compared with:
Chelsea	2.39 : 1	Kingston
Chelsea	2.38 : 1	St Benet
Chelsea	1 : 2.79	St Bride
Chelsea	n/a	Cross Bones
Kingston	1	St Benet
Kingston	1 : 6.64	St Bride
Kingston	n/a	Cross Bones
St Benet	1 : 6.61	St Bride
St Benet	n/a	Cross Bones
St Bride	n/a	Cross Bones

6.7.3.5 Metacarpals

Only two collections yielded a standard fracture ratio when observing the presence of metacarpal fractures in the OA population. As a result, St Bride is only 1.07 times more likely to have an OA with that type of fracture than those from Chelsea. All other comparisons were invalid.

6.8 COMPARISON BETWEEN THE AGE CATEGORIES

6.8.1 Prevalence rates

The true rates for each age category, divided by each possible marker of interpersonal violence and by collection, are presented in Figure 6.18 in order to gain a better understanding of the fractures' distribution.

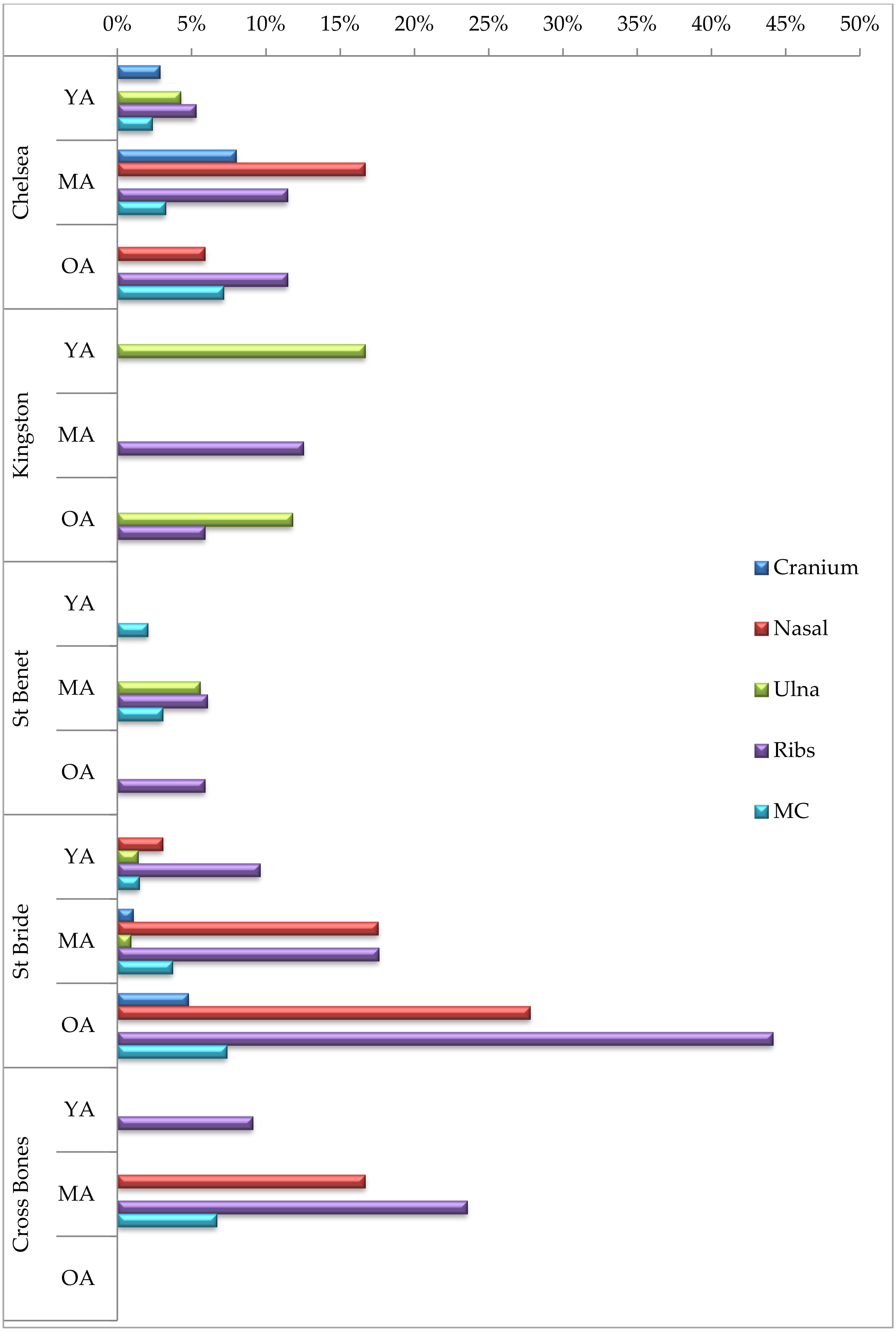


Figure 6.18 - The true prevalence rates for each possible marker of interpersonal violence for each age category in each collection, with the exception of Bowling Green Lane.

6.8.2 Chi-squared test results

Since the data for all three age categories were entered into one chi-squared test (Appendix 5, section 5.3.4), it was possible to use the same test when comparing age. As a result, it was found that the differences seen between the collections, according to each fracture site that is more commonly associated with interpersonal violence and when all three age categories are analysed, is statistically significant ($\chi^2 = 28.748$, df = 4, $p < 0.001$).

When the possible markers were analysed separately, it was found that the only result that was presentable is for the ribs as there is only 10% of the expected counts that are lower than five and the minimum is 4.29 which is well over the value of one. As a result, the differences seen between the collections when all the age categories are considered for this particular fracture type is found to be statistically significant ($\chi^2 = 28.413$, df = 4, $p < 0.001$).

6.8.3 Standardised rate ratios

The standardised rate ratios were then calculated for every fracture site seen within the age categories of the collective sample. Since the sample was divided according to age, sex will be the standardising variable for the following calculations.

6.8.3.1 Cranium

The MA in the sample are 2.11 times and the OA are 2.99 times more likely to suffer a depressed cranial fracture than the YA in the sample. Furthermore, the OA are 1.42 times more likely to display the same fracture type than the MA.

6.8.3.2 Nasal

The ratios seen between the age categories are very high for the nasal fractures. The MA are 9.18 times more likely and the OA are 9.98 times more likely to have individuals with a nasal fracture than the YA in the sample. The ratio between the MA and OA is but a fraction of the above. The OA are only 1.09 times more likely than the MA to exhibit individuals with a nasal fracture.

6.8.3.3 Ulna

The ulnar fractures show a reversal in results seen in the two previous possible markers of interpersonal violence. The YA are 1.07 times more likely than the MA and 2.39 times more likely than the OA to have individuals with this particular fracture type. This is the only instance where the YA are more likely to have a fracture type than the older age categories and it refutes the hypothesis found in section 3.1.2.5 of Chapter 3. The ratio comparing the MA and the OA for fractures of the ulna finds that the former is 2.24 times more likely than the latter. Consequently, the young and middle adult age categories are always more likely to have an individual with this fracture type than the older adult age category.

6.8.3.4 Ribs

The ratios seen for the rib fractures return to what was seen for the depressed cranial and nasal fractures. The MA are 2.51 times, and the OA 3.88 times, more likely to have individuals with rib fractures than the YA in the sample. Additionally, the OA are 1.55 times more likely than the MA to have an individual with rib fractures.

6.8.3.5 Metacarpals

Finally, the ratios for metacarpal fractures do not stray from the norm. The MA are 1.77 times more likely to have an individual with this fracture type than the YA, while the OA are 2.85 times more likely than the youngest age category. Likewise, the OA are 1.61 times more likely to have an individual with a metacarpal fracture than the MA in the sample.

Summary

Mirroring what was seen when the fractures were grouped according to their anatomical position, the ribs have the highest fracture prevalence rates when exploring the possible markers of interpersonal violence. When the sample is divided according to the sexes and age categories, the ribs are once again the fracture site with the highest prevalence rate for every group. However, when observing the rates seen in the individual collections, Kingston found its highest rate in the fractures of the ulna in the collective sample, as well as in the female, young and old adult samples. Interestingly, the nasal fractures in Chelsea have the highest rate for the male and middle adult sample. As for the lowest rate, there are two fracture types that re-appear. When observing the collective sample, as well as the middle and old adults, it is found with the ulna. On the other hand, the depressed cranial fractures have the lowest fracture prevalence rates in the males, females and young adults. Finally, the old adult sample from the Cross Bones skeletal collection does not present any fractures that are possible markers for interpersonal violence.

The chi-squared tests results indicate that the differences seen between the collections, when grouped according to the possible markers are statistically significant for the collective sample. Furthermore, it was permissible to present the results of the ribs which were also statistically significant. The same situation was found for the male sample. The results for the females, middle adults and old adults were also statistically significant; yet, the results for the individual possible marker in each group could not be presented due to having more than 20% of their expected counts being lower in value than five. As a result, all the comparisons for each sex and age categories were significant with the exception of the young adults who did not have any presentable results.

The males are not more likely to have more fractures at every fracture site as the females are more likely than males of have ulnar fractures. This is similar to what was found in the previous Results chapter where the females were more likely to have a fracture on the upper limbs than the males. Furthermore, the highest ratio between the sexes is found in the metacarpals which mirrors the highest ratio found in the fracture of the hands in Chapter 5. When observing the standardised rate ratios associated with the comparison of the age groups, the old adults are more likely than the other age groups to have suffered a fracture more commonly associated with interpersonal violence with one exception; in the case of the ulnar fractures, the YA were more likely than both of the older age categories to have this type of fracture. Furthermore, the middle adults are also more likely than the old adults to have a fracture of the ulna.

As a result, these differences allow for the exploration and discussion of numerous topics that could further broaden our understanding of violence in the past. The following chapter will examine the recurring themes found within the three Results chapters and contextualised them according to the historical literature. Consequently, the research hypotheses stated in section 3.1.2 of Chapter 3 can be confirmed or refuted which will illustrate the possible presence or absence of fracture patterns and interpersonal violence in London during the 18th and 19th centuries.

Chapter 7
Discussion

> "[…] variations in violence cannot be explained simply by reference to an innate aggressive drive, to a consistent cultural style, or as a straightforward reflex of political conflict or economic competition."
>
> (Robb 1997: 138)

The current project has demonstrated that all of the populations studied were subjected to a degree of risk of skeletal injury during their daily lives. As far as the resolution offered by the current study permits, fractures were observed to affect individuals from all walks of life, whether they were rich or poor, male or female, and young or old. While fractures were found in every biological, social and economic group, some were much more likely to have fractures that were consistent with incidents of interpersonal violence rather than accidents, and vice versa. However, it is important to remember that the lack of evidence of soft tissue injuries is a limiting factor in this type of research and will underestimate the results since it is not possible to confirm their occurrence. Nonetheless, the study of ante-mortem fractures does present physical evidence of violence–related or accidental incidents causing fractures.

In this chapter, the obtained results will be compared with the information taken from the historical accounts in order to consider the extent to which the depictions of London life offered by each line of evidence support or contradict each other. Rather than following the development of the three previous chapters, this particular chapter will be divided according to the hypotheses presented in section 3.1.2 of Chapter 3; however, it does not follow the order in which they were presented in Chapter 3. Furthermore, once the hypotheses have been discussed, the cumulative data collected from 18th- and 19th-century London will be compared with data published from three other sites found in Britain, with similar dates of interment. Finally, the data utilised in the current project will also be compared to data retrieved from two clinical samples.

7.1 NOT AS SIMPLE AS RICH VERSUS POOR

When looking at the collective skeletal sample, the first thing that quickly becomes very apparent is that formulating a hypothesis stating that the rich will have a lower fracture rate than the poor does not reflect the more complex situation that was found in London during the 18th and 19th centuries. While it is true that the poor burial ground of St Bride did have the highest overall crude fracture prevalence rate (36.74%), the lowest rate is not found within either of the two communities of higher social and economic climate, Chelsea and Kingston, whose crude rates are 22.42% and 23.81%, respectively. Interestingly, the mixed, with a larger number of poor interments, burial ground of St Benet (10.5%) presents the lowest fracture rate when observing the collective sample. Additionally, the lowest crude fracture prevalence rate is also found in this burial ground when observing the male, female and young adult populations separately. Evidently, the largest difference in the crude prevalence rates was found to be between St Benet and St Bride within those three biological groups. The aforementioned result has been a recurring theme throughout the previous Results chapters.

7.1.1 Same geographical area, very different outcomes

Geographically speaking, the burial grounds from St Bride and St Benet are very close to one another; yet, the way of life found within each parish and city ward must have been different in order to produce such different results. The City had very strict social controls, much more enforced by the authorities than in other areas of London (Sheppard 1998: 196), which presents the question of how the fracture rates are so different for two burial grounds, that have slightly different social and economic statuses, found within the City. Poor interments are present in both burial grounds, the small difference being that St Benet had some wealthy individuals buried within during its early stages of use prior to the vault in St Stephen's Church becoming their preferred resting place (Rowsome 2000: 69).

As mentioned in section 3.2.4.1 of Chapter 3, the City became a core for business of all kinds, both domestic and international (Sheppard 1998: 212-213; Thorold 1999: 18) around the turn of the nineteenth century; as a result, many wealthy individuals such as businessmen and their families could be found living within the area. Many stately manors and large familial dwellings could be found in the City during the eighteenth century (Sheppard 1998) which definitely accounts for the burial of wealthy individuals in the early years of use of the burial ground of St Benet. As for St Bride, it is located in the ward of Farringdon Without, which is also found in the City's limits and has a similar social and economic situation. Yet, there are some rather different characteristics found between the two areas. Pugilism and baiting were common in Farringdon Street during the eighteenth century (Bayne-Powell 1937: 170-171; Richardson 1995: 117-118; Shoemaker 2004); additionally, the Bridewell workhouse, which later became a prison, as well as the Fleet Street prison were found within the boundaries of Farringdon Without (Hitchcock 2004: 162; Noorthouck 1773; Picard 2006: 335; Thornbury 1878). As previously mentioned in section 3.2.5.2 of Chapter 3, records from St Bride's Church indicate that individuals from the workhouse, which formed a considerable percentage of the interments, as well as 41 prisoners, 28 males and 13 females, were buried within the Lower Churchyard (Miles and Conheeney 2005: 75-76). These differences could have had a very large impact on the poor populations found within each of these two wards and the subsequent trauma patterns found on the skeletal material from each burial ground.

7.1.1.1 St Benet

The early eighteenth-century notion indicating that violence was no longer the urban gentry's prerogative, which evidently became more and more intolerable after the 1760s and 1770s (Shoemaker 2001, 2004), may have created a sort of blanket effect which reduced the amount of violence seen within Walbrook ward. Stone (1983: 29-30) suggests that the upper-classes' less violent behaviour influenced the poor individuals to also conduct themselves in a similar manner. Since wealthier individuals were more commonly found within Walbrook ward, it appears that it may have had an effect on the lower sectors of society and contributed to the fewer number of fractures seen in St Benet.

In the upper-classes, defending one's honour with violence was no longer revered considering that reputations began to be built on values such as cordiality, politeness and an individual's economic success (Carroll 2007: 23; Shoemaker 2001) rather than on the public's opinion of an individual's ability to defend himself/herself, or their proficiency in responding swiftly and forcefully to threats and insults, as it had been prior to the eighteenth century (Clark 1992; Shoemaker 2004). Assaulting strangers on the street for the smallest of infractions, such as bumping into someone, no longer seemed important or worth one's time and was certainly not the newly preferred way for a man to assert his masculinity.

Since the gentry's attitude and exhibition of violence had changed and was no longer as visible in public life, it is conceivable that the poorer population of Walbrook Ward would also want to emulate the new behavioural model in order to become more appealing to prospective employers. A good reputation was essential for both men and women during this time as it allowed for trade and business relationships to be built as well as facilitating courtships and marriages. It also validated that individuals of such a reputation were to be generally considered as respectable members of society (Shoemaker 2004: 51). Furthermore, the poor population would often rely on the upper-class for employment; therefore, in order to achieve long-term stability in an area, networking was an important aspect of daily life for the poor. These ties, either formal, informal, or with kin would be extremely important, especially when unskilled or casual work needed to be found to support oneself or one's family (Green 1995: 94).

As such, one can infer that the decline of public violence firstly promulgated by the wealthier population, as well as the vastly important social connections built among residents and the importance of a good reputation, could serve to explain the lower fracture prevalence rates seen on the skeletal material stemming from the mostly poor interments from the St Benet Sherehog burial ground in Walbrook Ward.

7.1.1.2 St Bride

As opposed to the positive blanket effect brought by the upper-class' behaviour in Walbrook Ward, the presence of a prison and workhouse could have had an opposite effect on the population of Farringdon Without. For many of the poorer individuals of the population, being arrested and jailed within the workhouse was at times the only available option in order to eat and receive needed medical attention, even though such institutions were despised by most of the poor population (Hitchcock 2004: 138-139). Some would resort to more serious offences, such as disorderly conduct, in order to secure imprisonment for a longer period than the usual amount of time served in a workhouse, which could be as short as a week (Hitchcock 2004: 144). Furthermore, violence and rioting was a common occurrence in prisons due to the easy access to alcohol (George 2000: 291); hard labour, physical punishment and humiliation of the prisoners were the norm (Amussen 1995: 10; George 2000: 274; Hitchcock 2004:

166) and were at times performed with vicious enthusiasm by prison authorities (Morgan 1973: 70). The fact that prisons were rife with corruption (Reilly 2009: 40) certainly would not have had a positive effect on reducing the amount of violent behaviour found in the prison system. Likewise, the strict social controls were taken to a new level in the Ward of Farringdon Without after 1769, due to its City council appointed representative of the ward, or alderman, John Wilkes, who was described as being very authoritarian and violent himself (Thornbury 1878).

Fleet and Farringdon streets were popular areas for leisurely activities, for both rich and poor individuals, especially owing to the presence of markets. As aforementioned above, the majority of the entertainment in this area revolved around violence with the immense popularity of boxing and baiting (Bayne-Powell 1937: 170-171; Richardson 1995: 117); and, interestingly, women's boxing was also very popular in this area (Richardson 1995: 118). The Fleet Street market was located near the prison, and some individuals would seek entertainment by attending the public corporal or capital punishments of prisoners (Noorthouck 1773). This attendance was very characteristic of life in the metropolis and was in fact a large contributor to disorderly conduct seen on the streets, more so during the eighteenth century than the nineteenth century. In point of fact, the attendees were encouraged to add to the prisoners' shame by engaging in violent behaviour against the offenders in the pillory or stocks (Shoemaker 2004: 80). With so many examples of violence being a normal form of punishment, as well as being encouraged, or sadly, possibly used as a last resort to procure food and shelter from the elements, the higher overall fracture rate seen in this burial ground is a likely consequence.

The burial grounds from St Bride and St Benet both support and refute, respectively, the hypothesis that the poor individuals will have more fractures.

Yet, the results from St Benet are the most noteworthy as this particular burial ground, which was mostly used by the poorer population of the City's Walbrook Ward, displays a much lower fracture rate than the two collections which would be classified as being wealthy and affluent, Chelsea and Kingston. These results support Walker's (1997: 165-166) statement suggesting that variations in the presence of interpersonal violence, culturally and historically speaking, could very well have had an effect on the different frequencies seen when observing skeletal injuries from individuals in the same geographical area. Evidently, grouping the communities under various general characterisations has proven to be a method that is not always applicable.

7.1.2 The presence of interpersonal violence in poorer communities

This sub-section will expand on the above information regarding the overall presence of fractures and explore the prevalence rates of the possible skeletal markers of interpersonal violence in the collections from the poorer communities. The skeletal material from St Bride, St Benet as well as the pauper burial ground of Cross Bones will be explored.

7.1.2.1 St Bride

Fractures on the skull, which includes facial and mandibular fractures, have been found to be much more indicative of interpersonal violence as opposed to lesions located on the upper and lower limbs (King et al. 2004: 304; Laski et al. 2004; Owens 2007: 475; Torres-Rouff and Junqueira 2006: 63) as well as being linked to social and cultural specificities, such as domestic violence, boxing and ritualised fighting (Larsen 1997; Walker 1997, 2001). When observing St Bride's true fracture prevalence rates for the anatomical areas, the highest true rate is found in the torso (22.71%) followed by the fractures on the skull (12.68%). Lovell (1997: 166) states that fractures of the cranium, ribs and hands are much more indicative of interpersonal violence than fractures to the ulna.

Incidentally, this is reflected in the rates found for the possible makers of interpersonal violence in St Bride where fractures of the ribs (21.36%), the nasal bones (15%) and the metacarpals (3.9%) have the three highest true rates whereas the fractures of the ulna (1.01%) have the lowest.

A large numbers of rib fractures, located on both sides of the ribcage, are also indicative of such activity when combined with nasal fractures (Hershkovitz et al. 1996: 177; Lovell 1997). Rib fractures are a complex fracture site as they are caused by impacts to the chest which can be the result of both violent interactions as well as accidents. There are 66 individuals in St Bride who display one or more rib fractures which equals 21.36% of its true sample (n = 309). Within those individuals, 256 ribs or rib fragments were fractured: 175 of the ribs or fragments had at least one transverse fracture line with some having multiple transverse fracture lines, while only 92 fragments had one or more oblique fracture lines. As a result, the presence of multiple transverse fracture lines on the ribs, along with the nasal fractures, points to interpersonal violence being present in St Bride.

Undoubtedly, violence played a role in daily life within the area of Fleet and Farringdon streets. Walker (1997; 2001: 582-583) explains that violent behaviour sanctioned by a ritualised social context, such as boxing, may be emulated by the general population outside of that context. As a result, men from the ward of Farringdon Without, who were exposed to such fighting methods as a form of entertainment, could very well have transmitted that learned behaviour into their public and private lives, and used violence to defend their honour and settle quarrels based on the fracture prevalence rates mentioned above for the skeletal sample from St Bride. Incidentally, the data from this particular skeletal collection certainly adds weight to the fact that sanctioned violence, both as a form of leisurely pursuit or by participating in state punishments, was a popular pastime and it appears to have influenced the general behavioural patterns in this specific area of London during the eighteenth and nineteenth centuries.

7.1.2.2 St Benet

The highest true prevalence rate in St Benet when observing the fractures' distribution according to the anatomical areas was found to be in the lower limbs (5%) followed by the torso (4.62%). Typically, lower limb fractures are much more likely to be indicative of accidental incidents (Rodriguez-Martin 2006: 206-207), and are usually caused by a fall higher than one's own height (Judd 2002b: 51; Judd and Roberts 1999: 240). The rib fractures are exhibited on three individuals (2.46%) and the majority are oblique lines that appear unilaterally on the ribcage; however, that is not to say that none of the rib fractures were due to interpersonal violence. Nevertheless, in this case, the high presence of lower limb fractures in addition to oblique rib fracture lines appear to indicate that accidents were the more common cause of fractures in the population from St Benet.

The cranium and nasal bones, two very distinct areas where fractures are commonly associated with violence, did not present any ante-mortem fractures in the collection from St Benet. The other three possible markers (i.e. the ulna, ribs and metacarpals) all have very low true prevalence rates; the ribs' rate of 2.46% is the highest true fracture prevalence rate for this collection. While accidents appear to have caused most of the fractures seen in St Benet, it cannot be ruled out with certainty that violence was not present in the Walbrook Ward. Nonetheless, it seems that the presence of upper-class individuals, who believed that violent reactions were no longer acceptable in society and who revered restraint, had a profound effect on the behaviour displayed by the poorer individuals in Walbrook Ward.

7.1.2.3 Cross Bones

Unlike the St Benet burial ground, the overall crude fracture prevalence rate for this pauper burial ground (24.44%) was very close to the fracture rate that was found for the collective sample (27.05%). Miller (1852: 251) describes Southwark as being an area that "looks so murderous, so melancholy and so miserable." which saw its residents living in extreme poverty and overcrowded conditions compared to other areas of London (Reilly et al. 2001; Reilly and Southwark 1998). In fact, Booth's (1969: 31) survey, *Life and Labour of the People in London,* originally published in 1889, explains that the boroughs of Southwark and neighbouring Bermondsey had close to 68% of their population of 33,000 inhabitants living in poverty compared to the rest of London. Moreover, breweries had emerged as an important trade for Southwark (Johnson and City of London 1969: 304) which meant that alcohol was easily attainable. Brothels and prostitution were also notoriously common in this suburb of the City (Noorthouck 1773; Roberts and Godfrey 1950; Sheppard 1998: 196), as well as a number of individuals with menacing reputations such as felons, outlaws, thieves and vagabonds (Higham 1955: 232; Walford 1878b). Furthermore, the area of Redcross Way, where the Cross Bones burial ground is found, proved to be the area of Southwark where violent behaviour, robbery, drunkenness and prostitution were at their worst (Reilly 2009: 57). Poverty and drunkenness are intertwined, and violence can very well be the consequence (Bayne-Powell 1937: 197; Holme 1972: 74). As a result, this particular area of London during the eighteenth and nineteenth centuries appears to be a perfect context for the propagation of violence related fractures, especially if an individual's environment is correlated with the tendency to exhibit violent behaviour.

In this particular burial ground, the torso has the highest true fracture prevalence rate (13.64%) followed by the lower limbs (6.67%). The true rates found on the skull, upper limbs and feet are all very similar at approximately 4.6% while the hands are found to have the lowest rate (2.7%). When looking at the fractures that are more commonly associated with interpersonal violence, the skeletons from Cross Bones showed no depressed cranial fractures or fractures of the ulna. The most prevalent true rates are found in the ribs (11.63%) and are closely followed by nasal fractures (10%). One particular individual, [171], a male between the ages of 36-49, suffered both a nasal fracture and 13 rib fractures where some rib fragments exhibited multiple fracture lines, different stages of healing and predominantly transverse fracture lines. Another male, [119], aged between 36-49, was found to have a nasal fracture along with three transverse fractures on two ribs which present different stages of healing. As such, violence related injuries were present in the parish of St Saviour's.

Similarly to the influence of the public state punishments and subsequent encouragement for the general public to participate in such violence, the daily lives and exposures encountered by the residents of the borough of Southwark contributed to the physical evidence of interpersonal violence. With the extreme poverty and the more lenient social regulations compared to those of the City, Southwark became the area where criminals, dishonourable individuals and those rejected by London's upper-classes would converge (Thorold 1999: 103; Walford 1878b). Consequently, violent tendencies were probably more so visible in such an area and affected how individuals interacted with one another, especially when insulted or settling a dispute. However, this area does not display the same amount of possible markers of interpersonal violence that is seen in the skeletal material from St Bride's Lower Churchyard. Nonetheless, it appears that violence was much more present in the communities of St Bride and Cross Bones than in St Benet, and that the effects of socially sanctioned violent behaviour touched the lives of many.

7.1.3 The presence of interpersonal violence in wealthy communities

Both the collections from Chelsea and Kingston had a higher fracture prevalence rate when compared to the one from St Benet. As a result, the location of the fractures seen in these two burial grounds will be scrutinised in order to determine if the higher rates are due to the presence of interpersonal violence or augmented by the presence of more accidental fractures.

7.1.3.1 Chelsea

Fractures can be found in every anatomical area of the skeletons from Chelsea, yet the true prevalence rates are all under 10%, which is relatively low. On the other hand, according to Holme (1972: 74), the crime and violence seen in London had not bypassed Chelsea and it had developed a disagreeable reputation due to drunkenness and crime. Robbery on the roads to and from Chelsea had also become a problem during the eighteenth century (Croot 2004).

When taking a closer look at the possible markers of interpersonal violence, the rib fractures (7.94%) and nasal fractures (6%) have the highest true rates, followed by depressed cranial fractures (2.65%). Out of 24 fractured ribs or rib fragments, ten fractures had an oblique line while 15 had a transverse fracture line. Furthermore, some of these ribs had multiple fractures and displayed different stages of healing, a sign that is generally acknowledged to indicate physical abuse (Kimmerle and Baraybar 2008: 203; Lovell 1997: 166; Oxenham 2008: 7; Walker et al. 1997: 465). Six individuals had one rib fracture; singular fractures are often a sign of suffering a direct blow (Galloway 1999ab: 107; Judd 2002a: 102; 2002b: 50; Rodriguez-Martin 2006: 205) rather than being injured by an accidental fall, or an event producing much more force, which would mostly likely produce multiple fractures due to the larger area of impact. Due to the top three prevalence rates in this collection, the notion promoted at the time that violence was solely a working-class problem (Clark 1992) is dispelled since interpersonal violence was present in post-medieval Chelsea while being very restrained in the poorer population of St Benet. It is quite possible that the violent behaviour went unnoticed in Chelsea, especially if kept inside the privacy of the household. Or, the violent interaction could have been done clandestinely to avoid unwanted negative attention from officers of the peace (Shoemaker 2001: 200), owing to the fact that violence was becoming more and more socially intolerable as the eighteenth century progressed into the nineteenth.

Of course, some of the fractures seen in the individuals from Chelsea were due to accidents. Chelsea was still very much in a rural area and agriculture was an important industry until its decline towards the mid-nineteenth century (Walker and Jackson 1987: 153). Furthermore, the town, while keeping a village-like atmosphere, became more and more crowded during that time (Borer 1973; Walker and Jackson 1987). The top three true fracture prevalence rates when observing the fractures' dispersal according to the anatomical areas are the torso (9.92%), followed by those on the lower (6.34%) and upper limbs (5.34%). The presence of oblique fracture lines on the ribs of the individuals from Chelsea mentioned above is an indication that some of the fractures on the torso may have also been caused accidentally (Galloway 1999b). The subsequent highest prevalence rates found in the lower and upper limbs indicate that the presence of accidents could have very well been linked to manual labour in the fields or to the newly chaotic streets. As aforementioned, lower limb fractures are typically caused by accidental incidents rather than violence (Rodriguez-Martin 2006: 206-207) especially when falling higher than one's own height (Judd 2002b: 51; Judd and Roberts 1999: 240). In the case of upper limb fractures, they are also caused accidentally (Galloway 1999b; Judd 2002b: 51) when the hands are outstretched to break a standing fall (Court-Brown et al. 2010: 63). Six individuals are found to have fractures on the upper limbs: four individuals with radial fractures, one with fractures located on both the left ulna and radius, and one with a fractured ulna. Only one individual presents an upper limb fracture that is more indicative of violence which illustrates the fact that accidental fractures were present in Chelsea and may have been more so than fractures attributed to violent interactions based on the fracture prevalence rates. Nonetheless, the presence of violence in such an affluent area could play a part in confirming the universal presence of domestic violence, or wife-beating, which will be discussed further in section 7.3.

7.1.3.2 Kingston

Unlike Chelsea where the highest true fracture prevalence rate was found in the torso, the individuals from Kingston had the highest true rate in the upper limbs (15.39%), while fractures on the torso followed with a much lower true rate of 5.26%. This might suggest a higher propensity to defend oneself by raising the arm to deflect a blow. Interestingly, there are no fractures to the skull in this collection, which could indicate that the upper limb fractures were much more accidental than related to interpersonal violence. The very small sample size could very well have affected that outcome; however, the limited amount of available fractures still has a story.

When examining the possible markers of interpersonal violence, the Kingston population only displays fractures of the ribs (7.89%) and ulna (6.25%). Moreover, the fractures of the ulna seen in Kingston are more consistent with accidental causes due to visible damage on the proximal ends of the bones as well as displaying oblique fractures with visible displacement (Judd 2008). On the other hand, the rib fractures display transverse and singular fracture lines which characterise violent incidents rather than accidental in nature. Since nasal fractures and fractures of the metacarpals are absent from this sample, it encourages the idea that interpersonal violence, especially public fights, were much less frequent than in other parts of London. In fact, leisurely pursuits were not as prominent in Kingston until the 1800s and if such activities were too boisterous, they would be quickly dispelled by the authorities (Sampson 1997: 20). Furthermore, the Quaker population of Kingston kept to themselves for fear of being targeted due to their religious non-conformism (Sampson 1997). As such, it can be concluded that even though the Quaker community had a very private nature and that violence was not socially rampant in Kingston-Upon-Thames, a very small number of individuals would undoubtedly be negatively affected because of their religious views and beliefs, even with the introduction of the Toleration Act in 1689 which allowed freedom of worship (Pulford 1973: 6; Sampson 1997).

Clearly violence was seen everywhere, no matter the community's social and economic climate. However, the rate at which we can physically analyse such behaviour already appears to greatly depend on the individuals' environment. The fact that the lowest fracture prevalence rate out of all the skeletal collections is from a mixed burial ground, with a higher number of interments of poor individuals, speaks volumes. Furthermore, when looking into the different lifestyles of these communities, the social norms are much more indicative of violent behaviour than the economic affluence of those interred within the respective burial grounds.

7.2 The strong and violent man versus the dainty and fragile woman

This section will focus on the hypothesis that men will have sustained more fractures than women simply due to the different lifestyles, such as work conditions and social constraints seen in post-medieval London. England was very much a patriarchal society at the time and many who enjoyed that power and venerated its good governance, did not tolerate any disruption to the household order (Amussen 1994; Green 1995; May 1978; Meldrum 2000). Women were viewed as being a threat to employment especially in typically male trades such as tailoring (Green 1995: 89-90). As a result, men would try to earn enough income so that their wives and children did not have to work to support the family, which would in turn appease the patriarchal ideals of the society. If women needed to work, the men would restrict the type of employment available to them (Green 1995; Johnson and Nicholas 1997).

7.2.1 Gendered violence

7.2.1.1 Men

The hypothesis stated above is immediately confirmed when looking at the males in the collective sample as they are 1.39 times more likely to have suffered a fracture during their lifetime than their female counterparts. When observing the location of fractures according to anatomical areas in the male population, the torso (17.94%) has the highest crude prevalence rate while the skull, the upper and lower limbs all display crude rates that are close to 7%. It is highly unlikely that they are all solely due to accidents since violence in general was very much tolerated in the eighteenth century and perpetrators were often not prosecuted unless they committed murder (Beattie 1986: 75; Hurl-Eamon 2005: 2). As a result, violent behaviour was most likely exploited when retaliating against another individual, even with the decrease of interpersonal violence that occurred during the 19th-century (Shoemaker 2004). The fracture rate ratios of possible markers of interpersonal violence seen between the sexes were very high. They were all above 3.6 times more likely in favour of men in the case of depressed cranial fractures, nasal fractures and metacarpal fractures which are indicative of participating in hand-to-hand combat (Hershkovitz et al. 1996: 177; Lessa and De Sousa 2004).

The literature is in concordance with the data as men were not only exposed to more risks causing accidental fractures, they were also more violent. In fact, men were encouraged to be violent and were accustomed to fighting; especially those who had served in war efforts (Black 2009; Wiener 1998). Violence for men was very much a public activity, such as the boxing matches briefly described above. It was also used to defend reputations, settle disputes as well as being an indication that a man could protect his family and holdings; yet, the use of violence was controlled by a set of rules (Amussen 1994; Shoemaker 2004; Wiener 1998). Violence was so integral in the male identity and ideal of manliness (Shoemaker 2001, 2004; Wood 2004) that it started very early in life as play fighting, a common pastime among boys (Shoemaker 2004: 155; Wood 2004: 173).

7.2.1.2 Women

While the results showed that men are overall more likely than women to have fractures, women proved to be 1.29 times more likely than men to have fractures located on the upper limbs. The fractures are mainly located on the humerus and radius which is more indicative of an accidental injury (Rodriguez-Martin 2006: 206-207). When focusing on the markers of interpersonal violence, women were also 1.53 times more likely than men to have fractures on the ulna. However, many of the ulna fractures had oblique fracture lines that occurred on the proximal or middle shaft of the bone which points to an accidental cause (Judd 2008).

Violent behaviour was considerably gendered in England during the eighteenth and nineteenth centuries. Women were usually excluded from ritualised violence in order to depend on a man for protection and defending their honour, while his response to such an offence also re-affirmed his own sense of honour (Shoemaker 2001: 196; 2004: 159). What was important for a woman was her propriety (Wiener 1998: 200) and they were seen as the submissive and passive sex as well as being much more sensitive towards others (Shoemaker 2001: 196; 2004: 169). As a result, for a woman to uphold her reputation, the esteemed and appropriate actions and behaviours did not revolve around her ability to defend herself. On the other hand, female violence was not unheard of, the popularity of female boxing matches being a clear example (Richardson 1995: 118; Shoemaker 2004: 169-170); yet, as the data and Hurl-Eamon (2005) suggest, they evidently were less likely to resort to such behaviour.

7.2.2 Differences in risk factors in the rich and poor communities

The rich and the poor had very different lifestyles which highly affected the amount of risks encountered by both sexes. For example, accidental fractures were much more likely to happen to men of lesser means rather than women of the same circumstance due to type of employment available for each sex, where many jobs available for the lower classes revolved around physicality, and being more exposed to the chaos found on the city streets. However, the different social status of each sex is omnipresent, which deeply influences how men and women lived their respective lives regardless of their economic status.

7.2.2.1 The poor

The poor women worked in order to contribute to the financial stability of the home. Clark (1992: 189) argues that marriages in the lower social classes were seen as a partnership since the family depended on two incomes. As a result, rather than overseeing the running of the household, which more often than not was a slum and shared with other families, poor women would find work outside the home (Picard 2006: 304). However, the options for female employment were limited, and scantily paid (Clark 1992: 197), to sectors that were related to household responsibilities, such as domestic service, laundering, retail or as a seamstress (Green 1995: 23; Sheppard 1998: 223). The men, on the other hand, would find casual or unskilled work which usually centred on manual labour as they depended on their hands rather than their heads (Earle 1989: 3). Inferring that men were much more exposed to industrial or street accidents is plausible. Yet, women were still exposed to some risks due having to get to work while manoeuvring the chaos on the streets.

7.2.2.2 The rich

As for wealthier women, they were encouraged to oversee the running of their household while the men participated in the public sphere of life and earned an income (Meldrum 2000). For families who could afford such luxury, the idea of a woman working outside the home, let alone earning an income, was non-existent. The upper or middle-class men would rely on inherited wealth or use their heads to earn an income, rather than getting their hands dirty and engaging in physical labour (Earle 1989: 3). However, since the men would be part of the public sphere rather than be exclusive to the private sphere, they would simply be exposed to many more risks than the women left confined in their households.

By the nineteenth century, public displays of violence were no longer tolerable. As previously mentioned, during this time, men were more and more encouraged to emulate behaviour deemed more civilised and sensible, and they were deterred from resorting to violent outburst to settle disputes. Words and insults to attack another’s reputation, which had typically been a woman’s weapon, had become the norm for men as well (Shoemaker 2004). However, this does not mean that violence completely disappeared from everyday life; it simply became more of a private matter endorsed by the ideals of English society. Even though women were less likely to suffer fractures, they were not immune from acts of violence, especially at the hands of male members of their family.

The data supports the notion that men were much more at risk of suffering a fracture during their lifetime regardless of their social and economic circumstance. However, the number of fractures suffered very much depends on an individual's environment; subsequently, as aforementioned, it is not as simple as stating that the poor will have more fractures than the rich. On the other hand, fractures in the female population of London are present in every skeletal collection and the next hypothesis aims to discover the links with domestic violence and wife-beating.

7.3 WIFE-BEATING

The patriarchal society of England had a very large influence on domestic violence. Discipline was exercised physically among families (Beattie 1986: 74); and, as mentioned in section 2.3.5.1 of Chapter 2, marital chastisement was seen as a man's right (Amussen 1994; Clark 1992; Doggett 1992; Hunt 1992; Meldrum 2000; Shoemaker 2004: 158; Travers 1997) with society expecting and requiring women to repent by accepting such punishment (Hurl-Eamon 2005: 56; Travers 1997: 101-102). Domestic violence is rooted in the desire for control, domination and obedience (Amussen 1994; Hunt 1992; Perciaccante et al. 1999; Pinker 2011) which is perfectly suited to the ideals of a patriarchal society. The data portrays women as being less violent than men and it is quite possible that women refrained from that behaviour not only because it was socially unacceptable for a woman to be anything but respectable and proper, but because they risked the danger of undermining their husband's sense of manliness and authority or embarrassing him (Wood 2004: 108). Consequently, this could quite possibly have led to a beating as the wife's behaviour was commonly used as provocation and justification for physical punishment (Amussen 1994: 73; Hunt 1992; Travers 1997: 11; Wood 2004: 63).

As violent behaviour became more and more unacceptable throughout the eighteenth century and beyond, wife-beating was deemed a very private matter that did not warrant discussion outside the household and was increasingly hidden behind closed doors (Carroll 2007: 23; Shoemaker 2001; 2004: 175-176); yet, neighbours would be very much cognisant of its occurrence in other households (Amussen 1994). Further aggravating the problem of domestic violence was the legal system's unresponsiveness to the presence of such cruelty. Members of Parliament and the police would be very reluctant to disturb the balance of power held by the husband when ruling his household (Clark 1992; Doggett 1992; Travers 1997) as this would disrupt a belief significantly ingrained and integral in English society. Magistrates would often support the men when such incidents occurred (Wood 2004: 108). Additionally, strangers and neighbours would simply look the other way when they witnessed wife-beating and would only intervene if the punishment, and subsequent severity of the injuries suffered by the wife, reached an unacceptable level (Amussen 1994: 84; Clark 1992: 188). This allowed wife-beating to continue while violent activity towards others was generally on the decline (Beattie 1986; Carroll 2007; Shoemaker 2001; 2004: 175-176; Travers 1997).

7.3.1 Gentlemen do not beat their wives

As discussed in section 7.2.2.2, men of the upper classes were encouraged to relinquish their violent tendencies in order to be more courteous, polite and chivalrous (May 1978: 140; Wood 2004: 40). As a result, domestic violence and wife-beating was very much classified as a working-class problem since descriptions of upper-class marriages were happy, blissful and equal; it was unimaginable that they would be affected by such a delinquent issue (Hunt

1992: 27, citing John Stuart Mill's *The Subjection of Women* (1869)). Interestingly, the two more affluent communities in this sample, Kingston and Chelsea, seem to reflect this ideology of domestic violence being a working-class problem.

7.3.1.1 Kingston

In Kingston, the only fracture type more commonly associated with interpersonal violence that is present in the female skeletal assemblage is ulnar fractures. In the true sample (n = 16), 6.25% of the females from this burial ground were affected. Only one female exhibited this type of fracture and while both ulnae were affected, all injuries are located on the proximal ends of the ulnae. Consequently, the injuries reveal an accidental cause (Galloway 1999b: 141; Judd 2008: 1665). As a result, this community very much adheres to the proliferated perception that violence against women only took place in a more destitute population. Based on what was previously learned regarding daily life of the Quaker community of Kingston-Upon-Thames, violence was not a common occurrence at all which also appears to have been the case in their private lives.

7.3.1.2 Chelsea

When observing the possible skeletal markers of interpersonal violence, Chelsea only has one result: 6.67% of true female sample (n = 45) have one or more rib fractures. Of the three females with such fractures, one has a singular transverse fracture which tends to indicate a localised blow as a result of violence (Judd 2002b: 50). The second female has unilateral oblique fractures on three ribs while the third female has a mixture of oblique and transverse fracture lines on six ribs with some exhibiting different stages of healing. With the additional fact that the fractures all occurred on the same side of the ribcage, it is rather difficult to determine their aetiology with certainty for this last female. As a result, it appears that wife-beating was present in the upper-class individuals found in Chelsea, yet it does not seem to have been very prevalent.

Based on the results from Chelsea and Kingston, it appears that violence against women may have indeed been a working-class problem, as the newspapers and parliamentarians at the time promoted. It is quite possible that the men in the upper-classes took to heart the notion that civility and courtesy were much more appropriate behaviour and restrained from violent tendencies. On the other hand, in spite of the propaganda and the above results, there is some literary evidence that wife-beating was very much present in the more affluent communities. Still, this evidence, such as reports of servants witnessing their master's wrath towards their mistress (Meldrum 2000: 93), is rare as these occurrences were very much ignored and upper-class men who beat their wives would be classified as being an anomaly (Beattie 1986: 124; Travers 1997: 13).

7.3.2 Domestic violence in Farringdon Without

As aforementioned, the individuals from the St Bride burial ground display the highest fracture prevalence rate when compared to all other collections included in the current study. As a result, it is not surprising to find that the females from St Bride display prevalence rates in all five possible markers of interpersonal violence. It is the only female collection where this occurs as all others present at least one possible marker with a rate that is equivalent to zero. The highest true prevalence rates for St Bride are seen in the ribs (17.76%) and the nasal bones (6.9%) which is conclusive with an aetiology caused by interpersonal violence (Hershkovitz et al. 1996; Lovell 1997). One female, [2383], between the ages of 35 and 49, presents a nasal fracture, multiple bilateral rib fractures and a fracture on the left radius. Ten ribs or rib fragments were affected showing a mixture of oblique and transverse fracture lines, with some displaying up to three fractures on one fragment and some displaying different stages of healing. Consequently, it appears that [2383] had been a victim of abuse. Furthermore, the true prevalence rates for all possible markers are highest in the St Bride burial ground when observing all the collections, with the exception of the ulna which is found to have a higher true fracture prevalence rate in both St Benet and Kingston.

The description of life in the ward of Farringdon Without found in section 7.1.1.2 portrays an environment that encouraged public displays of violence. Clearly, it also affected the dynamic found within households. The perception of a savage working-class was exacerbated by the reality surrounding the easy access to alcohol and the resultant heavy drinking by the poor (Doggett 1992: 118; May 1978: 160-161; Travers 1997). Adversely, part of the blame for the presence of domestic violence was placed on working-class women as they were characterised as not having proper domestic habits compared to their more affluent counterparts (Travers 1997: 10-11). The idea existed among London society that men of the lower classes would have a higher tendency to react violently and exhibit such behaviour in public and private due to the squalid housing conditions, low earnings and having little power that was so important to English society (May 1978: 160-161). This is certainly corroborated by the data found in the female sample from St Bride and it supports the characterisation of lower-class men being destructive, brutal and savage (Doggett 1992: 120; May 1978; Travers 1997). However, the females from the predominantly poor St Benet burial ground and the pauper Cross Bones burial ground appear to present a different reality.

7.3.3 Marital partnerships

The Industrial Revolution brought many fundamental changes to London that affected all aspects of daily life (Green 1995; Sheppard 1998). It certainly affected the social and economic circumstances of the City and its boroughs

(Floud and Harris 1997), which in turn shaped the concept of patriarchal power and the resultant sexual division of labour seen within London. Meldrum (2000: 41-42) mentions feminist historian Bridget Hill's argument found in *Women, Work and Sexual Politics in Eighteenth-Century England* (1993) that this change cemented a strong sexual division of labour by abolishing the family economy and forcing women to occupy their time with the running of the household. This may very well have been true for the more affluent individuals where the husband's income was sufficient to support the members of his family and household; however, the situation is rather different in the poorer communities of London.

The higher social status and power given to men saw its strength diminish within the poorer communities as it seems to have been affected by the Industrial Revolution and the realities of the economy (Clark 1992; May 1978). The Industrial Revolution opened the door for women to have access to different types of better paid work, due to machinery that did not rely on the necessity of physical strength (Johnson and Nicholas 1997: 204). Unlike in the upper-classes, where women were very much confined to their homes and marriages were more indicative of a relationship of dominance and submissiveness, marriages between poor individuals were viewed as a partnership (Clark 1992: 189). These individuals barely had enough money to cover basic necessities, and as a result, the women, and often children, would be required to work in order to contribute to the family's financial wellbeing (Clark 1992: 189). Accordingly, this allowed for barriers to be broken regarding equality between the sexes and made for a sharing of responsibilities between a husband and wife (Johnson and Nicholas 1997: 204).

7.3.3.2 St Benet

This skeletal assemblage saw only one female with a skeletal marker of interpersonal violence, a fracture of the left ulna, which accounts for 2.63% of the true number of females (n = 38) from this cemetery. However, the fracture line is oblique, located at the mid-shaft and paired with a fracture of the radius (Figure 7.1). These features are not conclusive of interpersonal violence as paired fractures occur when the force acting on the forearm is greater than the amount of protection the ulna can provide the radius when for example, elevating the arm to deflect a blow to the head. Such a force would be encountered when breaking a fall with outstretched arms (Judd 2002a: 93; 2004: 46; 2008: 1662). Interestingly, this fracture prevalence rate (2.63%) is lower than the one found amongst the women from the Kingston burial ground who similarly only presented ulnar fractures (6.25%) as a possible marker for interpersonal violence in the female population. This suggests that violence was not solely a lower class problem as the propaganda emphasised. The dehumanising characterisation of the lower-classes does not encompass the complexities affecting daily lives in various communities which in turn influence the fracture prevalence rates seen between them.

Figure 7.1 - Paired oblique fractures on the left ulna and radius of a female aged between 36-49 years. MoL CHB - ONE94 [20]

As a result, it appears that the description of life in Walbrook Ward presented in section 7.1.1.1 very much influenced the presence of violence in the community and also had an effect on the behaviour of men towards women. Since the majority of individuals in the mixed burial ground of St Benet were poor, wife-beating should have been present if the propaganda was true for all poorer communities. However, it appears that the business-like partnership between spouses had an effect on the absence of wife-beating. If the wife suffered any injuries such as a fracture, due to a beating at the hands of her husband, her capabilities of earning a living were affected, which in the end was a major detriment to the family and essentially her husband as he had legal authority over her earnings (Clark 1992: 193). The pauper burial ground of Cross Bones provides another example supporting the idea that wife-beating was much less present in the poorer populations and in direct contrast to the notion promulgated by London's officials.

7.3.3.2 Cross Bones

If the idea that despairing communities were breeding grounds for male violence, in comparison to the more prosperous areas, was accurate, the borough of Southwark, based on the description of the area presented in section 7.1.2.3, should demonstrate a large amount of violence against women. Yet the data from this area, a perfect environment for violence due to the extreme poverty and resultant living conditions, the immoral persons found within, as well as the availability of alcohol, does not reflect such an assumption regarding violence against women.

Interestingly, while prostitution was punishable by law in other areas of London (Hitchcock 2004; Meldrum 2000; Sheppard 1998), resulting in a few days of hard labour in a workhouse, it was tolerated in Southwark (Tames 2001: 43). The parish and its officers formulated a code of restrictive conditions which offered some protection for prostitutes against physical violence, entrapment, forcible work when sick or pregnant, and forcible confinement, in an attempt to reduce the nuisance of this ever-present trade; nevertheless, such a woman would not be able to disguise her profession, her subsequent position in the social hierarchy and would have to be buried separately from the rest of the population (Tames 2001: 43). With so many brothels in the area, prosecuting all these women would probably have been an endless aggravation in the eyes of the parish. On the other hand, prostitution did allow a poor woman to earn a small income (Hitchcock 2004: 88), and not have to rely on the parish for financial support. Since parishes were always looking for a solution to the poverty problem (George 2000; Hitchcock 2004; Wood 1991), allowing prostitution, while enforcing certain rules and ensuring protection, most likely alleviated the need for parish support and relief for a large group of individuals.

Initially, Cross Bones was a burial ground for prostitutes and eventually welcomed the interment of paupers (Bard 2008: 115; Holmes 1896: 309). There is only one female (4.55%) out of a sample of 22 that exhibits fractures that could be possible markers of interpersonal violence. Her fractures are all located on the ribs: found unilaterally on the left side, displaying different stages of healing and presenting both oblique and transverse fracture lines. Considering that the sample exhumed from this burial ground contained more female than male skeletons, the limited number of females with possible markers of interpersonal violence is surprising.

The results seen in the St Benet and Cross Bones burial grounds reinforce the notion that it is definitely not as simple as grouping wealthy and poor populations together with the idea that they will all present a similar outcome according to their social and economic contexts. Based on the results, violence was present in every community and especially so in St Bride. However, rather than focusing on the idea that wife-beating was less prevalent in the affluent communities, it would appear that the lower rate of domestic violence in some of the poorer communities is the more striking result. It could very well be the aftereffect of the realities faced by the working-class couple where their marriage was inevitably treated as a partnership rather than a dominant-submissive relationship. Furthermore, the parish of St Saviour's desire to offer prostitutes protection against assaults seems to have also quelled the supposedly rampant phenomenon of violence against women in the area. However, this does not automatically dismiss the notion that wife-beating did not exist. Soft tissues injuries are not apparent on bone and may very well account for a large number of incidents of violence against women, including the possibility of sexual assault, which cannot be confirmed with the study of skeletal material. With the husband's right to chastise his wife, within certain boundaries, domestic violence was a reality in 18th- and 19th-century London; yet, it seems to have been falsely branded as a class problem rather than a gender problem.

7.4 Analysing patterns according to age and its complications

Age should have a very large impact on the number of fractures an individual will suffer over the course of their lifetime (Larsen 1997: 118; Mays 1998: 176; Roberts 2000: 345). They are intrinsically linked to one another, especially in industrialised societies, and emphasised by age-related bone loss (Dolinak 2008; Larsen 1997: 118). Fundamentally, the longer a person lives, the longer the exposure to risks and the more fractures they can possibly accumulate over their lifetime. Initially, when observing the collective sample, the data support this theory as the older adults are more likely to have a fracture on their skeleton than both the middle and young adult age categories. In fact, the fracture prevalence rates would increase categorically alongside the age groups. However, analysing fractures based on age groups can be very complex. Once the remodelling process has begun, it is nearly impossible to determine at what age a fracture occurred as they could very well have occurred within months or years of the time of death (Larsen 1997: 118; Roberts 2000). This reality can call into question when the fractures occurred in an individual's lifetime and how that affects the results obtained from the skeletal material.

7.4.1 Increase of fractures with each age category

In order to get a more precise view of the collective sample's results, the prevalence rates for each age category were separated according to the individual burial grounds. Chelsea, Kingston and St Bride all display an increase in the number of individuals with fractures as they get older. Some individuals from Chelsea and St Bride display fractures with larger and disorganised bony calluses and observing the presence of such fractures can potentially reveal more information regarding the age at which the fractured occurred. If the fractures reveal very little healing and are made of primary or woven bone, they occurred within a few weeks to a few months of the time of death (Lovell 1997: 144; Roberts 1991: 236). As a result, these two burial grounds will be explored further in order to observe if the presence of such fractures affected the trend seen in the collective sample.

7.4.1.1 Chelsea

The fracture rates may very well increase according to the age categories when observing the fractures regardless of their anatomical location; however, there are some interesting outcomes when observing the fractures from Chelsea. While the rate of fractures in the torso, the hands and the lower limbs all display a progression according to age, the old adult age category do not present any fractures on the feet. Moreover, when examining the possible markers of interpersonal violence, the skull and subsequent nasal fractures, as well as the upper limbs show a higher rate in the middle adults.

There are only four individuals who presented healing fractures in this collection. Three individuals have such fractures on their ribs: one male in the old adult category, one female in the middle adults and another female in the old adult category. The presence of these individuals in the sample does corroborate with the data stating that the older individuals will have more fractures in the torso even if there is a limited number of them with unhealed or healing fractures on the ribs. The fourth and final individual from Chelsea who displays a healing fracture, this time located on the skull, is a male in the middle adult category, which also supports the above information. Unfortunately, one middle adult presenting a healing fracture is not enough to refute the above mentioned anthropological and epidemiological notion. There simply is insufficient information, especially regarding the presence of healing fractures which are present on four individuals out of 37 with a fracture, to formulate a conclusion regarding these outcomes. Speculating on the cause for the higher rates seen in the younger age categories could be endless and subsequently futile.

7.4.1.2 St Bride

The poor individuals from St Bride present the perfect anthropological and epidemiological situation when looking at healed fractures found in various age categories. When observing the fracture prevalence rates based on the anatomical areas of the body, these rates increased for each area while progressing from the young adult age category to the old adult. The same is true when observing the fractures that are possible markers of interpersonal violence, with the one exception: the ulnar fractures. In this case, the young adults have the highest rate and there are no such fractures in the old adults.

Interestingly, when observing the presence of healing fractures in St Bride, there are eight individuals who present such fractures. However, two individuals are indeterminate adults and as a result cannot provide any information useful to clarifying when the fractures occurred during an individual's lifetime. The healing fractures are all located on the ribs which unfortunately do not yield any additional information regarding the higher rate of ulnar fractures in the young adults. Nonetheless, these rib fractures are dispersed over: two females, one middle adult and one old adult, and four males, one young adult and three middle adults. While this could be used to reject the data's support of the osteological paradox, especially among the males, six individuals is not enough to change the amount of data collected over 133 individuals with a fracture from this burial ground.

7.4.2 Higher fracture rates in middle adult age category

Chelsea, Kingston and St Bride immediately display a positive link between the number of fractures and the individuals' ages when looking at the collective sample. However, this is not the case for the burial grounds from St Benet and Cross Bones.

7.4.2.1 St Benet

From the very beginning of this chapter, the individuals interred in the burial ground of St Benet have been nullifying some of the hypotheses due to its very low fracture prevalence rate. The trend continues when comparing the fracture rates seen in the three age categories. When looking at the fractures regardless of their anatomical location, the old adults have a fracture rate that is approximately 4.4 percentage points lower than the rate found in the middle adults. Furthermore, when observing the healing fractures found in St Benet, there is only one individual with such a fracture: [508], a male between the ages for 35 and 49. He has a total of eight ribs that are fractured; of which four are healing fractures. In the end, the lone individual with healing fractures is found within the middle adult age category and could be used as evidentiary support to dispel the notion that the number of fractures exhibited by an individual is directly correlated with their age.

It is difficult to infer the reasons for this higher fracture rate in the middle adult age category as the literature does not focus much on age except to make the distinction between the life of adults and children. However, there is some indication that many beggars were older individuals who could not work where physical strength was necessary due to their age and obvious physical disabilities (Hitchcock 2004: 9). Maybe the older individuals were less at risk of suffering new fractures compared to younger individuals who were more active. However, since there is only one individual with a healing fracture in St Benet, it is not possible to come to a definitive conclusion as to why this occurred. Maybe it simply lies in the demography of the exhumed research sample as there is a 212% increase in the number of middle adults when compared to the number of old adults from the St Benet skeletal assemblage. The literature does not give any clues to why there is such larger number of individuals in the middle adult age group, yet it clearly appears to have affected the number of individuals with fracture that is found in each group when analysing this particular burial ground.

7.4.2.2 Cross Bones

The burial ground of Cross Bones presents an even more peculiar observation. The middle adult category features a difference of 23 percentage points between its crude rate (41.18%) and the one that follows which is the young adults' rate (18.18%). Consequently, the old adults have the lowest fracture rate (14.29%) seen in the age categories in Cross Bones. Incidentally, this is the lowest old adult crude prevalence rate seen in any of the collections. Unfortunately, none of the individuals from Cross Bones displayed a healing fracture.

Since interpersonal violence was on the decline, the older individuals would presumably have been exposed to public displays and the possible physical repercussions of such behaviour and would have been more likely to participate than the younger generations. However, the older individuals from Cross Bones do not have any fractures that are more commonly associated with interpersonal violence. On the other hand, the middle adults display fractures on the ribs, on the nasal bones and on the metacarpals. Maybe this is related to the idea that an individual could be more likely to die at a younger age if they engaged in more violent behavior and that individuals were able to reach the oldest age category because they shunned such behaviour and escaped the risk of an early death due to being more careful. Nonetheless, as mentioned many times in the literature, the objective of sanctioned violence, outside the realm of war, was not to fatally injure the opponent. Regrettably, since there are no individuals with a healing fracture, the possibility of explaining these outcomes is not feasible.

All this is to say that being able to determine when fractures occurred during an individual's lifetime, other than those transpiring close to the time of death, is very difficult. Furthermore, Roberts (1991: 227) and Judd (2002a: 91) both state that this type of data means little as fractures seen on skeletal material could have occurred at any time prior to the individual's death. Unless the fracture occurred close to the time of death, or at most, a year prior to time of death, there is no method to estimate with absolute certainty when that fracture occurred during an individual's lifetime. While older individuals should have a higher number of fractures due to having lived longer, it is also quite possible that some of the younger individuals died as the result of their injuries and were obviously not in a position to accumulate more. Or, maybe some of the older individuals had fewer fractures and evidently survived longer due to distancing themselves from violence as much as possible. Consequently, it is very problematic to infer the exact reason for the discrepancies found in St Benet and Cross Bones. There are a number of possibilities, most notably: the Industrial Revolution with its new technologies and machinery, and the very large influx of people that occurred in the 18th and 19th centuries. Maybe the middle adults received more fractures as they were getting accustomed to the new way of life and new jobs where more severe accidents were possible. However, not only do we not know when the fractures occurred during the course of an individual's lifetime, many of these poor individuals could not afford a burial marker which means that the individuals' name and especially their date of death is unknown. The date of interment could very well have been at the beginning of the burial ground's use or at the end, and in that one hundred year span it is quite obvious that many changes occurred in the social and economic climates found in post-medieval London. In the end, however, this is all conjecture and until fractures can be positively aged according to an individual's age, we may never know the reason for these discrepancies.

7.5 The presence of fractures in London and Britain

This section will provide a comparison of the fracture prevalence rates found in 18th- and 19th-century London with the rates found from three other sites in Britain: St Martin's Churchyard in Birmingham, a site with burials from the late 18th century to the early 19th century (Brickley et al. 2006b); St Peter's Church in Wolverhampton, a 19th-century overflow cemetery (Adams and Colls 2007); and West Butts, an 18th-century Baptist burial ground in Poole, Dorset (Mckinley 2008).

7.5.1 Collective sample

Overall, the crude fracture prevalence rate for the adults from the burial grounds used in the current study, who suffered a fracture over the course of their lifetime, is 27.05% (343/1268). The collection from St Martin's presents a crude prevalence rate of 30.4% (107/352) for the adults in the sample (Brickley et al. 2006a: 120), which is higher than what is seen in London during a comparable period of time. On the other hand, the two other burial grounds, St Peter's and West Butts, present adult crude prevalence rates that are lower than what was found in London. Within the burial ground of St Peter's, 23.9% of the adults exhibited a fracture (Arabaolaza et al. 2007: 65), while fractures were found in only 12% of the adult population of West Butts (Mckinley 2008: 77).

7.5.2 Sex

When analysing the differences seen between the sexes, the crude fracture rate for the males in London (33.57%) is higher than what was seen in the females (21.73%). This is also seen in each of the three other sites. In St Martin's case, the rates were calculated based on whether the individual was buried in a vault or an earth cut grave. Since no such distinction was made in the current project, the rates for both burial contexts were added in order to retrieve a crude prevalence rate for each sex. It was found that 41.44% (75/181) of the males from the St Martin's burial ground had a fracture as opposed to only 17.83% (23/129) of the females (Brickley et al. 2006a: 120). As such, the males from St Martin's are 2.28 times more likely to have suffered a fracture than the females in the sample. This is a much higher odds ratio than the one seen in London where the males are 1.39 times more likely than the females to exhibit a fracture. Furthermore, when analysing the presence of fractures for each sex, it was found that the males from St Martin's are 1.21 times more likely to have fracture than those from London. On the other hand, the females from London are 1.22 times more likely to have fractures than those from St Martin's.

The West Butts burial ground reveals that 15.39% of the male population (4/26) have a fracture while a lower 11.36% is representative of the female sample (5/44). Interestingly, the females make up 61% of the sample while the males account for 36% of the West Butts burial ground (Mckinley 2008: 77). Even so, the males were 1.36 times more likely to suffer a fracture over the course of their lifetime compared to the females from the same burial ground. When compared to the rates from the skeletal material from London, the males were 2.27 times more likely and the females were twice as likely to suffer fractures if they were from London rather than the West Butts burial ground. As for the collection from St Peter's, it simply mentions that the males have a higher crude rate than the females before it presents the rates according to specific bones (Arabaolaza et al. 2007: 65).

The burial ground from St Martin's also displays the true rate for nasal fractures since it is a possible marker for interpersonal violence. Interestingly, they are only found in the male population with a very low rate of 1.98% (5/253) (Brickley et al. 2006a: 126). On the other hand, London's true rate for the male population sees that 15.09% of the 159 males with a left or right nasal bone present display such a fracture. As such, the males from London are 7.55 times more likely to display a nasal fracture than those from St Martin's. Quite interesting when the overall rate of males with a fracture in St Martin's is almost 8 percentage points higher than London's male sample. However, London's true rate does not include the information gathered from Bowling Green Lane which could have affected the results had its skeletal inventory been complete.

The burial grounds for St Peter's and St Martin's also present the rates found for fractures on the hands or the metacarpals. When observing the fractures from St Peter's, a 9.1% crude prevalence rate for metacarpal fractures was found in the male population (Arabaolaza et al. 2007: 65) while only 3.62% of the collective male population of London present the same fracture. St Martin's presents a true rate of 5.9% for the male sample when observing fractures present on the hands (Brickley et al. 2006a: 126-127) while London's true rate, calculated without the information from Bowling Green Lane, is 6.27% for the males with fractures on the hands. Finally, there is an overall consensus when observing the presence of rib fractures in these skeletal assemblages as they are the bone with the highest fracture rate for both sexes.

7.5.3 Age

When observing the distribution of individuals with a fracture based on London's collective sample, it follows what was seen in St Martin's: the number of fractures grows according to the progression of age categories (Brickley et al. 2006a: 121). The individuals from St Peter's present a different outcome where the young adult and middle adult (with a top age of 45 rather than 49, as is used in the current project) have a higher fracture prevalence rate than the older age category. In this case, more than 50% of the individuals in the younger age categories have at least one fracture visible on their skeleton (Arabaolaza et al. 2007: 65-66). As for the individuals from West Butts, due to the small sample size, it appears that the individuals were classified within a number of age categories that do overlap. As a result, it is not possible to compare the fracture prevalence rate according to age categories as many also cover an age range that could fit in two of the age categories used in this project.

7.5.4 Clinical sites

The data from the current study was also compared to the data from two clinical sites, 1907 London and late 19th-century New York City. The data was found in Berger and Trinkaus (1995) and was originally published in Wood Jones's (1910) *Fractured bones and dislocations*. It was chosen due to its similar categorisation to the anatomical locations used in the current study. Furthermore, it gives a glimpse of the rate of traumatic lesions seen within a hospital setting after the period of interest both in the same area as well as overseas.

Interestingly, the fracture rates seen in the collective sample from 18th- and 19th-century, or post-medieval, London was almost always much lower than what was seen in 1907 London and New York (Table 7.1). The only instance where the post-medieval site has a higher fracture rate is in the torso. The upper limbs, hands and lower limbs have much higher fracture rates when observing the two clinical samples. It may be possible that this is due to a higher number of accidental fractures occurring after 1900, due to the presence of more machinery and higher construction for example. But this is conjecture since discovering the reasons for this large increase in these anatomical areas lies outside the scope of this thesis. However, the table does show that fractures continue to be a part of everyday life no matter the time or the place.

Table 7.1 - The crude prevalence rates for the post-medieval (PM) sample from London as well as clinical samples from London in 1907 and late 19th-century New York.

Site	Skull	Torso	Upper Limbs	Hands	Lower Limbs	Feet
PM London	5.6%	14.51%	5.84%	2.76%	5.68%	2.29%
London 1907	6.2%	7%	31.6%	24.4%	23.6%	7%
New York	13.7%	12.3%	25.3%	21.9%	20.6%	5.6%

Summary

The occurrence of fractures in general does not discriminate based on an individual's age, sex or social and economic circumstance. Accidental fractures can happen to anyone, anywhere. Nevertheless, the ante-mortem fractures' location and their relevant prevalence rates will not be identical for every individual or group.

The first issue that became very apparent is that one cannot simply characterise skeletal collections into groups, such as rich and poor, and expect that all the collections in the same group will produce the same result. This was especially clear when observing the rates found from the burial grounds of St

Bride and St Benet. They have two very different outcomes, yet are both located in the City and both are cemeteries for the poor, with the small exception of St Benet also having some wealthier interments during the initial use of the burial ground. As such, the visible and encouraged violent behaviour seen in the ward of Farringdon Without had an effect on its population. On the other hand, the wealthier patrons of Walbrook ward, where civility and cordiality were much more revered male qualities than asserting masculinity with brute force, very much had an effect on the poorer population who called the parish of St Stephen's home.

When the presence of interpersonal violence was observed in the poor populations, the results emulated the rates found when observing the collective sample. The collections from St Bride and Cross Bones support the notion that individuals will emulate the behaviour seen during leisurely pursuits such as boxing (Walker 1997: 165; 2001: 582-583) and that poverty and despair contribute to the presence of violence (Bayne-Powell 1937: 197; May 1978: 160-161; Pinker 2011: 305); just like the collection from St Benet supports the notion that the transformation of the concept of masculinity among the elite affected the low presence of violence in all social classes present in the community (Stone 1983: 29-30). When interpersonal violence was observed in the wealthy populations of Chelsea and Kingston-Upon-Thames, the rates were found to be low. Interpersonal violence did exist, yet due to the sharp change in manners, the individuals from Chelsea did not resort to such behaviour often. The population from Kingston has even less physical evidence of interpersonal violence present, most likely due to the nature of the Quaker community as well as the near nonexistence of forms of leisurely entertainment within this area. As such, the presence of violence can be seen everywhere, yet it is highly dependent on the social norms of the community itself.

When analysing the differences found between the men and women, it was clear that the men would suffer more fractures, both accidental and violence related, throughout their lifetime. The risks they encountered outside of the household on a daily basis made it so that they were more likely to suffer a fracture than their female counterparts. Furthermore, the sexes' distinct socially acceptable behaviour, where violence displayed by men could be acceptable for men and always reprehensible for women also had an effect on the number of fractures suffered by the sexes. Hence, men in general were much more violent and at risk of accidents than women which accounts for the higher fracture rate in that sex.

Wife-beating was present in 18th- and 19th-century London society, as it was very much seen as a husband's right and physical discipline of the individuals in his household was the norm. The communities from Chelsea, where very few females show fractures that could be related to interpersonal violence, and from Kingston, where the females show none of those fractures, appear to fully support the notion of wife-beating being a working-class problem. However, when looking at the poorer communities such as St Benet and Cross Bones, they refute this claim. The females from St Benet follow the collection's low fracture pattern seen throughout and barely display fractures that could be attributed to wife-beating. The same appears to be the case with Cross Bones, yet this is much more surprising based on the nature of the borough. As a result, it appears that the expected description of wife-beating being a major problem in poorer communities does not corroborate the situation found in some of the poorer areas of London.

Finally, the fracture rates seen according to age were analysed. St Benet and Cross Bones present results that contradict the anthropological and epidemiological model stating that the older a person is, the more fractures they will incur during their lifetime (Larsen 1997: 118; Mays 1998: 176; Roberts 2000: 345). These two collections present the middle adults as having more fractures than the old adults and interestingly, in Cross Bones the rate of the old adults is also lower than that of the young adults. Overall, there are simply too many uncertain variables, including the difficulty surrounding establishing when a fracture occurred during an individual's lifetime, to explain these occurrences. Additionally, only the date of use of the burial grounds is known (approximately 1750 to 1850) and since the poorer individuals did not have the funds to buy a burial marker, there is no date of death. As a result, we cannot know with absolute certainty when an individual was buried. Since the Industrial Revolution brought enormous changes to the lives of Londoners, that information would have been a great help to possibly determine how much exposure to violence or accidents these individuals encountered during their lifetime and if that changed within each generation.

Lastly as a final thought, a bioarchaeological approach to this type of study is indispensable. We must look deeper than that simple explanation in order to properly identify and define the reasons behind the violent acts and the population's capability to instigate them which is what this thesis has aimed to achieve.

Chapter 8
Conclusion

There is no sign that violence was invented in a singular location and then spread to others (Pinker 2011: 482); yet, it is evident throughout the world and has been since prehistoric times (Berger and Trinkaus 1995; Jimenez-Brobeil et al. 2009; Jurmain et al. 2009; Jurmain and Bellifemine 1997; Jurmain 1991; Kilgore et al. 1997; Lambert 1997; Pinker 2011; Standen and Arriaza 2000; Torres-Rouff and Junqueira 2006; Walker 1989; Wilkinson 1997). Every human being has the potential to engage in violent behaviour; however, more importantly is the fact that individuals also have the capability to restrain themselves from such behaviour.

As demonstrated over the course of the current thesis, violence and culture are intrinsically linked. The ideas and values promoted by a culture will have a profound effect on the degree of acceptable violence found within its community. As a result, the core of this thesis is centred on the violence that is found between family members and members of the same community, where fatally injuring the opponent is not the objective, rather than collective violence such as warring states. Concentrating on incidents of interpersonal violence allows for an understanding of violence outside of a more acceptable context (i.e. war).

The process of the decline of violence in Britain has spanned over many centuries with its changes especially felt during the 17th and 18th centuries (Cockburn 1991; Pinker 2011; Shoemaker 2004; Stone 1983). Nonetheless, violence did not cease to be an issue altogether in 18th- and 19th-century London. For example, while individuals of the same social class refrained from exhibiting violent behaviour towards one another, a man was still within his legal right to chastise individuals who were deemed to be inferior individuals to him: women, children, servants, and anyone within a lower social class (Amussen 1994; Clark 1992; Doggett 1992; Hunt 1992; Hurl-Eamon 2005; May 1978; Meldrum 2000; Pinker 2011; Shoemaker 2004; Travers 1997). Violence was clearly in evidence on the skeletal assemblage gathered for this current project in the form of healed or healing fractures. These bony lesions provide a range of information regarding the life experiences of various communities found within the City of London and its surrounding boroughs.

This concluding chapter will briefly recapitulate what has been seen over the course of this thesis with a focus on what the results have revealed regarding the presence of interpersonal violence in 18th- and 19th-century London. The principal conclusions and themes that emerged from the results will be revisited; and, future research possibilities will be briefly discussed and presented.

8.1 THE BIOARCHAEOLOGICAL APPROACH

The first step when undertaking such a project is to peruse the previously published studies of this nature in order to formulate research methods that are functional and optimal. Many studies offer suggestions regarding their own research methods or the methods of others and present possible improvements. The importance of such an approach when conducting these types of studies was a recurring statement in those publications. Accordingly, this method was utilised during the data collection process in the laboratory.

8.1.1 The importance of the collections' social and economic environment

Aggression and the urge to react violently is not a singular intention and neither does it build up over time to be eventually released (Pinker 2011: xxv). There are many different elements, such as environmental and social, that can affect a person's desire or instinct to react in such a way (Lambert 1997; Larsen 1997;

Pinker 2011; Torres-Rouff and Junqueira 2006; Van Der Merwe et al. 2010; Walker 1997). As a result, the community's social, cultural and environmental contexts are vital for interpreting the visible fractures seen from each community.

As mentioned in section 2.3.5.1 in Chapter 2 and section 7.1.1.1 of Chapter 7, the culture of honour and its defence morphed into a culture of dignity and civility for the upper classes where violence was no longer used to resolve quarrels between individuals. The resultant change in attitude towards violence also filtered down to the lower classes until it became integral to British society and culture (Carroll 2007; May 1978; Pinker 2011; Shoemaker 2001; Stone 1983). Pinker (2011: xxiii) describes communities of a higher social and economic class, who are respectful of their women, healthier and more educated as usually being more peaceable. While this statement may be true in a number of cases for past and present communities, the skeletal assemblage from the predominantly poorer burial ground of St Benet clearly proves that observing the presence or absence of interpersonal violence is not as simple as grouping communities into rich and poor. Each community will have factors that affect the degree and severity of violence found within, which in turn may very well not affect others in a similar manner.

8.1.2 The importance of analysing all available skeletal material

A bioarchaeological approach is superior in its findings because fractures can have a number of different causes that produce a similar result on bone (Judd 2002a, 2002b). As a result, during the laboratory phase of this project, each skeleton that was available for study was analysed for all visible ante-mortem fractures. Observing only one or a particular number of fractures rather than the totality of visible ante-mortem fractures seen on one individual, can lead to conclusions regarding their aetiology that are not fully sufficient in properly explaining what may have occurred (Judd 2002a, 2002b, 2004; Owens 2007). Furthermore, the bioarchaeological approach does not apply solely to the individual, where analysing the whole skeleton is much more preferable than focusing on one specific bone; it is imperative to focus on the collection rather than the individual. While case studies are a great way to gather information on one specific individual that may have presented peculiar injuries, they simply reveal just that: one case in an array of individuals who also suffered fractures. Therefore, it is as vital to analyse the collection as a whole in order to be able to properly interpret the presence of ante-mortem fractures and how they are related to the possible presence of interpersonal violence where fatally injuring the opponent was not the goal. In turn, it will produce a more accurate depiction of life in London during the 18th and 19th centuries.

This thesis goes another step further by analysing six collections from the same geographical area in order to see how the various contexts associated with each collection affected the presence of ante-mortem fractures found on the individuals from each burial ground. Evidently, based on the three Results chapters and the Discussion chapter, a proper and full comprehensive context for each burial ground was essential in order to properly understand the meaning behind the amount and types of fractures seen on the skeletal assemblages. Obviously, this method was imperative in the proper development of this thesis and should remain a vital part of any future study of this nature.

8.2 Fracture patterns and violence in post-medieval London

The fractures seen on the individuals from the six burial grounds that were analysed were used to answer the research questions and hypotheses that were introduced in section 3.1.2 of Chapter 3. The data revealed an array of insightful information which confirmed some hypotheses while refuted parts of others. Below is a brief summary of what was found.

8.2.1 Two poor populations, two outcomes

It was hypothesised that the poorer populations would present a higher prevalence rate of fractures, both in general and when observing the possible markers of interpersonal violence, than the more affluent communities as violence was promoted as being a lower-class problem in 18th- and 19th-century London. The poor population from St Bride's Lower Churchyard confirmed this hypothesis; however, the predominantly poor population from the St Benet Sherehog burial ground did not.

8.2.1.1 The poor population from St Bride exhibits more fractures

The individuals found within this poor burial ground located in the City of London's ward of Farringdon Without consistently presented higher prevalence rates when compared to the other burial grounds. Furthermore, St Bride is the only collection to have at least one individual who presents a fracture in every anatomical location as well as a fracture for every possible marker of interpersonal violence. When observing the fractures based on their anatomical location, St Bride's highest fracture rates were found on the torso and the skull, which are more representative of violent incidents (Lovell 1997: 166). This is mirrored with the high rate of rib and nasal fractures seen when observing the possible markers of interpersonal violence exhibited by the individuals from St Bride. Overall, this skeletal assemblage confirms the hypothesis that poorer individuals were more likely to suffer at least one fracture over the course of their lifetime than the wealthy. They were also more likely to have suffered more fractures that are possible makers of interpersonal violence.

Violence was a common daily observance for the residents of Farringdon Without as boxing matches were common and a popular form of entertainment (Bayne-Powell 1937: 170-171; Richardson 1995: 117). Furthermore, with the nearby location of the Bridewell workhouse and Fleet prison, the public punishment of prisoners also attracted spectators who sought to witness such events as the misery of those being reprimanded provided much merriment (Noorthouck 1773). The general public was also encouraged to participate in the execution of the chastisement and further humiliate the prisoners (Shoemaker 2004: 80). As a result, this collection could be used to support Walker's (1997, 2001) notion that continuously witnessing sanctioned violent behaviour will encourage its recurrence outside of that approved context. Of course, it is not possible to truly know how much of the violence present in Farringdon Without was witnessed by individuals who neither worked nor resided in the ward. Nevertheless, the fact that 95% of the individuals interred in the Lower Churchyard resided in the area prior to their deaths (Miles and Conheeney 2005: 83), and that exposure to violence was a frequent occurrence in this ward, Walker's (1997, 2001) theory can certainly serve as a possible explanation for the presence of elevated fracture prevalence rates among the individuals interred in St Bride's Lower Churchyard. Furthermore, the elevated prevalence rate in the collection from St Bride could also support the notion that poverty and despair will enable and fuel the presence of violence within a community (Bayne-Powell 1937; May 1978). In the end, the poor individuals interred at St Bride's Lower Churchyard faced a life entrenched with violence and it is evident when analysing the skeletal material.

8.2.1.2 The poor population from St Benet presents the lowest fracture rate

The individuals for St Benet present a remarkable difference from what was seen in the collection from St Bride. While these two burial grounds are both located in the City's limits and were predominantly poor burial grounds, their fracture patterns are at opposite ends of the spectrum. Furthermore, the fracture prevalence rates from St Benet were found to be lower than both of the more affluent skeletal collections: Chelsea and Kingston. When observing the fractures' distribution on the skeletons from St Benet, bony lesions were found in every area; yet, their respective prevalence rates were not very elevated with a maximum true fracture prevalence rate of 5% in the lower limbs. On the other hand, two possible markers for interpersonal violence, the nasal and depressed cranial fractures, were not present in this collection and the remaining possible markers presented a top rate of 2.46% for the ribs. As a result, it is more likely that the majority of the fractures suffered by the individuals in this burial ground were caused accidentally.

Clearly the environmental context of Walbrook Ward had a profound effect on the daily risks encountered by the residents. Many mansions and rich businessmen and merchants were found in this area of London (Borer 1973: 8; Denny 1997: 8; Earle 1989: 205-206; Thorold 1999: 18), and they would interact with the poorer individuals who were interred in the St Benet Sherehog burial ground. Since the upper-classes promoted and revered a non-violent and more domesticated behaviour (Shoemaker 2001, 2004), this could have had an effect on the behaviour of the lower classes, as Stone (1983: 29-30) suggests. Furthermore, the much lower presence of fracture prevalence rates in the sample from St Benet could support the notion that localised social networks were important to the unskilled or causal workforce, who were usually people of lesser means, in order to procure employment (Green 1995: 94). Therefore, the lower, or in some cases absent, fracture prevalence rates of possible markers of interpersonal violence seen in the skeletal material from St Benet could be explained by the fact that in order for the poor to obtain and retain employment, exhibiting behaviour that is promoted by the employer's social class would be a good strategy. As a result, this particular burial ground is the perfect example why one cannot simply presuppose that the violent, brutal and savage characterisation found in the literature regarding the poorer populations in post-medieval London will automatically be reflected in the skeletal material.

8.2.2 Men will suffer more fractures than women

When looking at the collective sample, as well as the fractures based on their anatomical location and the possible fracture markers of interpersonal violence, the men were consistently more likely to suffer a fracture as well as a higher overall number of fractures with the exception of fractures on the upper limbs as well as on the ulna specifically.

The higher fracture prevalence rates found in the male population are consistent with the lifestyle generated by English society's patrilineal ideals which produced a firm sexual division of labour as well as a social conformity associated with each sex. Violence had been ingrained into masculinity for a number of centuries prior to the period of interest. Settling disputes in the form of a duel or fistfight had long been an acceptable form of violence between men who felt that they had been wronged or insulted (Amussen 1994; Shoemaker 2001, 2004; Wiener 1998). As a result, men in general were simply much more exposed to the risk of sustaining a fracture by living the majority of their daily lives outside the home. Furthermore, a violent reaction was certainly much more acceptable when coming from a man even with such behaviour becoming less and less favourable over the course of the 18th and 19th centuries. These differences between the risk factors for each sex are reflected in the skeletal material.

8.2.3 Wife-beating is not strictly a lower class problem

While a general decline of violence towards other individuals was seen and reported beginning in early 17th-century England (George 2000; Sheppard 1998;

Shoemaker 2004; Travers 1997), the fact remained that a man's right to physically correct his wife's behaviour did not become illegal until the end of the 19^{th} century (Carroll 2007: 26-27; Perciaccante et al. 1999: 761-762). Furthermore, the strongly engrained sense of patriarchal power found in English society ensured that men would be very reluctant to give up that supremacy and the courts would be very averse to prosecuting such events so that the balance of power remained unaffected (Clark 1992; Doggett 1992; Travers 1997). Yet, domestic violence was classified as a lower class problem by the magistrates, media and elite (Beattie 1986: 124; Clark 1992; Hunt 1992; Travers 1997: 13) as the gentry was now promoting a less violent code of conduct.

The wealthier communities of Chelsea and Kingston do partly support the notion of wife-beating being a lower class problem as fractures more commonly associated with interpersonal violence were not widespread in those communities. While some women did show signs of such fractures, it was apparent that violence against women appeared to be sporadic. Furthermore, the higher prevalence rate of fractures found in the female sample in the poorer burial ground of St Bride also supports this belief. On the other hand, similarly to what was seen with the poorer population of St Benet not conforming to the preconceived notions that lower class communities will have more fractures, the same can be said with the presence of wife-beating when observing the female populations from St Benet and Cross Bones. This was really surprising for the female population from Cross Bones as this area was described as having the worst possible living conditions in the literature. It is reasonable to contemplate that Southwark would have been a perfect breeding ground for domestic violence; however, the skeletal material did not reflect this. Maybe the fact that prostitutes were tolerated in the area and a certain degree of protection was offered by the parish (Tames 2001: 43) led to this outcome. As a result, while the wealthier communities and poor community of St Bride support the belief that wife-beating was a lower-class problem, two of the three poorer burial grounds included in this study do not.

8.2.4 Fracture analysis based on age groups will always be difficult

Regrettably, when observing the skeletal material in regards to the presence of ante-mortem fractures according to the age categories that catalogues the analysed skeletons, a difficulty does surface. While it is possible to observe which age category is more likely to have individuals with fractures, it is not possible to ascertain with certainty when these fractures occurred over the individual's lifetime. Once fractures begin the remodelling process, endeavouring the task to determine exactly when the fracture occurred is a very difficult and at times an impossible undertaking (Lovell 1997: 118; Roberts 2000). Furthermore, Roberts (1991: 227) and Judd (2002a: 91) both state that this type of data means little as fractures seen on skeletal material could have occurred at any time prior to the individual's death.

The collective sample from Chelsea, Kingston and St Bride all present a skeletal assemblage that shows a progression in the number of fractures in correlation to the age categories. Interestingly, in Chelsea, the middle adults are found to have the highest prevalence rates in certain fracture locations and types while the young adults are found to have the highest rate of ulnar fractures in St Bride. Unfortunately, the presence of a small number of individuals with healing fractures in both collections yields very little additional information that could potentially form a conclusion on why this occurred. The poor burial grounds of St Benet and Cross Bones presented higher fracture prevalence rates in the middle adult age category. Out of these two sites, St Benet only has one individual with healing fractures which limits the amount of information that can be gathered from such an occurrence. Since the demographics of the St Benet skeletal assemblage had a much higher number of middle adult interments, this may have affected the lower rates seen in the old adults. As for Cross Bones, even the young adult age category has a higher fracture rate than the old adults. What's more, none of the old adults have a fracture characterised as a possible marker for interpersonal violence. Since there is only one individual who presents a healing fracture, there are simply too many unanswered variables, such as when the fractures occurred during the individuals' lifetime and their exact date of death, to form a concrete conclusion on the higher rate in the younger age categories. Maybe the older individuals survived longer because they refrained from violent behaviour; yet, this cannot be explicitly confirmed and remains conjecture. Unfortunately, the literature does not shed any additional light on these occurrences as differences in lifestyles and encountered risks are not made in accordance to age.

8.3 Future research possibilities

This project has revealed many interesting facts about life in London during the 18th and 19th centuries. Some of the hypotheses presented in Chapter 3 were confirmed while others were refuted; yet, it was also found that certain burial grounds, with a similar social and economic context, would provide either outcome in certain cases. In the end, the information retrieved from the skeletal material is vast and can be used to answer a number of other research questions. This final section will briefly explore an array of other research possibilities that can be undertaken on account of the database compiled for the current project.

A method of building on the current project would be to study the juvenile skeletons found within each of the collections used in this study. While the difficulties of analysing and studying juvenile skeletons were detailed in section 3.3.1.1 of Chapter 3, it is not an impossible feat. Similarly to what was undertaken with the adult skeletons, the same could be done with the sub-adults in order to discover their lifestyle and maybe observe the possible differences seen between the children and adults. This could shed some light on the presence of wife-beating and violence in the home since physically disciplining the members of his household was seen as a man's right. It would be interesting to see if the presence of wife-beating was correlated with the presence of child abuse.

Another possible avenue for further work would be to build on this project and add other post-medieval burial grounds from London to the database that has been created. This would allow for an even larger and clearer picture of the possible presence of violence in post-medieval London based on various communities with different social and economic status. The encountered small sample sizes did at times present statistical results that were not presentable. By adding more individuals, this would create a larger sample, which in turn would allow for additional and more powerful statistical tests to be performed. While the data collected during this project is categorical, as it will fall into either the "exhibits a fracture" or the "does not exhibit a fracture" category, not both, it limits the types of statistical tests that can be performed to the chi-squared test and the log linear analysis. However, if it is not possible to add more data in order to augment the observed and expected numbers above a value of five, it may be possible to change the categorisations used in this project in order to obtain other answers and perform other statistical tests. Based on this, a number of additional information can be researched that was outside the scope and time allotted for this particular project.

Finally, it would be interesting to add more burial grounds from other areas of Britain in order to compare the other areas with the fracture patterns seen in London. This could also be taken further by doing a chronological study on the presence of violence by adding Anglo-Saxon and medieval burial sites and corresponding data to the study. This would present physical evidence that would allow exploring the decrease of violence reported in the historical literature.

In the end, this project is but a stepping stone on what can be uncovered from skeletal material. This great source of primary evidence is of the utmost importance to truly understand the lives of past populations. While some outside the field may object to the study of human remains, such material does remain the best physical evidence of our past and is of vital importance. As a result, it should be properly analysed whenever possible.

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