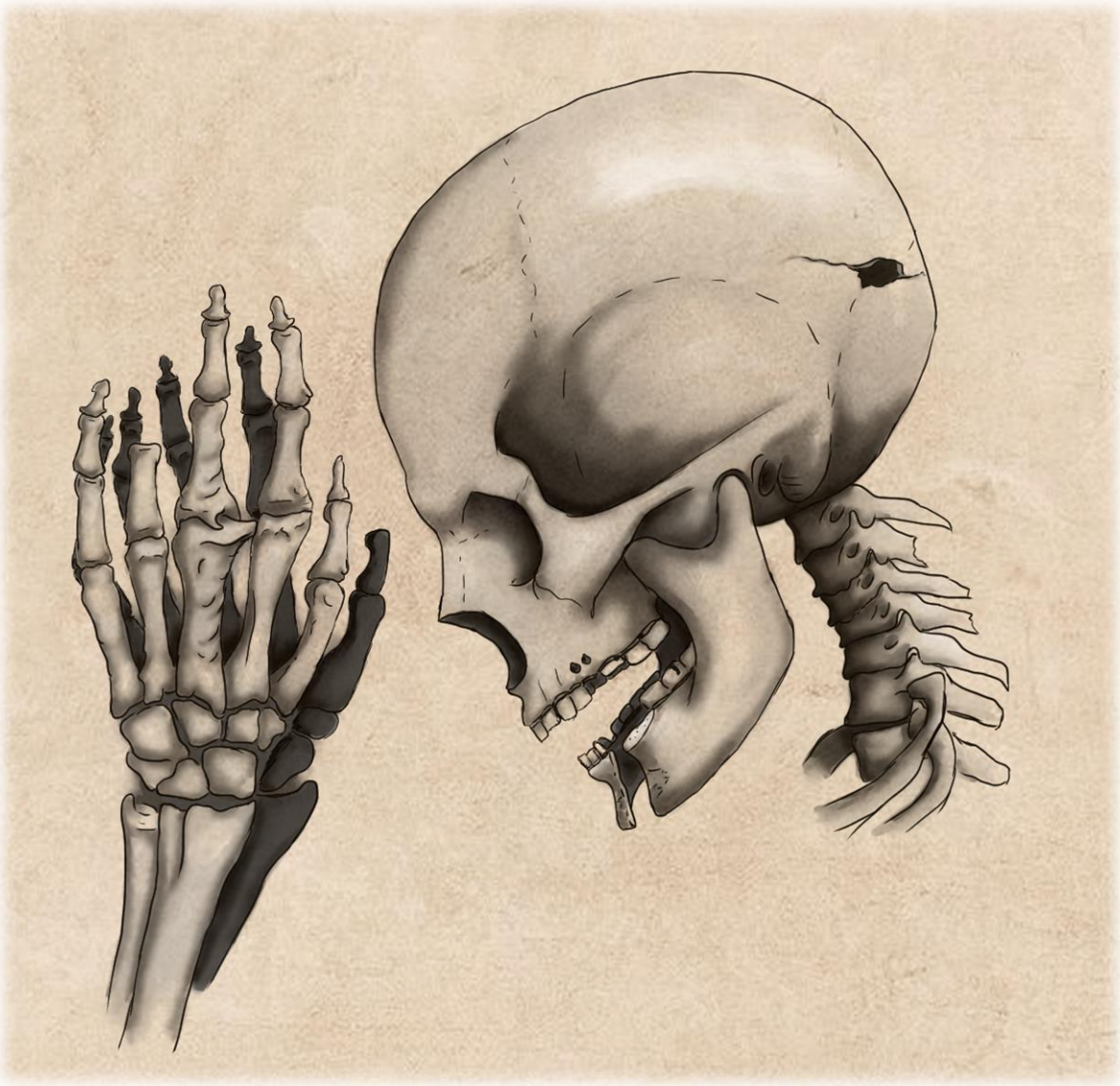
Paleopathology and Health in Medieval Oslo:

An osteological analysis of the pathologies present in the skeletal remains from St. Nicholas Church, Oslo and a comparison to contemporary London



Sara Georgine Fløien Schiøtz
University of Oslo, Department of Archaeology, Conservation, and History
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Cover illustrated by Sara Georgine Fløien Schiøtz, inspired by various skeletal lesions from St. Nicholas Church individuals

Abstract

This thesis examines the health and living conditions in Medieval Oslo, and test how they compare to the health and living conditions Medieval London. Medieval London was much larger than Medieval Oslo and at one point it had roughly 25 times as many inhabitants. Through this it is examine if the size of the Medieval town affected the health of its inhabitants. This has been done through non-destructive osteological analysis of the individuals from St. Nicholas Church from Oslo and the data was then compared to data from the Dominican Friary Carter Lane, London. A smaller percentage of the individuals from Oslo had any pathologies than the individuals from London had, and more of the pathologies from London are associated with various dietary deficiencies and contaminations of their living environment.

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1 Introduction

Health and disease are important aspects that affect all societies throughout the world and throughout time. By studying the overall health in a society, we can gain an insight into their living conditions. This thesis will examine the living conditions in Medieval Oslo through osteological analysis of individuals from St. Nicholas Church's (Nikolaikirken) cemetery, the church was in use during the period between 1240 and the 1460s (Norseng 1986:16, 23). The individuals in question are from a small portion of the southern end of the cemetery which was excavated by Norsk institutt for kulturminneforskning (NIKU, *The Norwegian Institute for Cultural Heritage Research*) in 2014-2015 as part of the Follo Line project (Follobanenprosjektet). The Follo Line project was the construction of a new double track of the railroad between Oslo S and Ski and it follows the route of the pre-existing Østfoldbanen (previously Smaalensbanen). The work cuts through the southern part of Oslo's Medieval town, which is automatically protected by law, and NIKU was hired for the excavation. During the excavation and work on the railroad human remains were discovered and the area of excavation was extended to cover the graves which would be in danger of destruction due to vibrations from the work on the railroad (Derrick 2018:19-22). After NIKU finished their examination of the human remains they were moved to De Schreinersk Samlinger (DSS, *The Schreiner Collection*), where the analysis of the material was done for this thesis.

As to connect the finding from Oslo to the bigger picture the data will be compared to data from Medieval London. Medieval London was a larger town than Medieval Oslo, both in size and in population (see sections 2.3 and 2.4 of this thesis), but it also had a greater population density and was a more important trade node (Gómez and Verdú 2017:2). By comparing the two towns we might gain an insight into how the size of a town affected its people. Only one cemetery from London has been used, the Dominican Friary of Carter Lane, London (site code PIC87) was selected due to the comparability between the two osteological collections. The Dominican Friary of Cart Lane is also known as the London Blackfriars and when referring to this collection I will call it the London Blackfriars. The northern part of its cemetery was excavated between 1987 and 1988 and there is a total of 58 individuals recovered, 57 of which were analysed. The Friary itself is dated from 1275 to 1538 (Bekvalac et al 2007; Gilchrist and Sloane 2005a:241).

There are multiple reasons as to why the London Blackfriars were selected for comparison with St. Nicholas Church. The collection chosen for the comparison should be

contemporary to St. Nicholas Church and include both sexes and all ages, which the collection from St. Nicholas Church also include. Both of these criteria fit with the London Blackfriars. Additionally, the comparison collection should be well-documented and the data should be easily available. On the Wellcome Osteological Research Database's website (Wellcome Osteological Research Database [WORD] 2022) all the relevant data for the London Blackfriars is available. While the London Blackfriars is not the only collection available through WORD (2022) it is the collection which is the most comparable with St. Nicholas Church. All the other Medieval cemeteries available are either not contemporary (e.g., in use for a longer period of time, or only in use at an earlier period of time than St. Nicholas) or not comparable in its use (e.g., Spital Square, which were connected to a hospital, or East Smithfield Black Death cemetery, which also were only in use for two years).

1.1 Research Question

Medieval Oslo was by no means a large town and during the 14th century it reached the height of its population with an estimated 3,300 inhabitants. At the same time London reached an estimated of at least 80,000 inhabitants (Bauer 2020:255; Hebbert et al. 2022). The overarching research question for this thesis is: How can pathologies and other health conditions from the human skeletal remains from St. Nicholas Church help us understand the health and living conditions in Medieval Oslo, and how would it compare to Medieval London which was a town of much greater size?

The research objective followed in this thesis include:

1. Analyses the osteological material from St. Nicholas Church to identify pathologies and other conditions relevant for the thesis.
2. Consolidate the data gathered from St. Nicholas Church and the data gather by WORD (2022) from the London Blackfriars into two comparable databases.
3. Interpret and compare the data from St. Nicholas Church and the London Blackfriars.
4. Identify any pathological patterns from either collection, and identify any overlapping ones.
5. Further identify any implications these pathologies and health conditions could have had for certain age groups.
6. Discuss the implications these pathologies and health conditions could have had for the two collections.

1.2 Thesis Structure

This thesis is structured into three parts, part one covering the background and context, part two is the materials, methods, and results, and the third part is discussing the results and, in some ways, combining information from the two first parts. The first part includes chapters 1 through 3, where chapter 1 introduces the project while also covering the research question and the ethical part of the thesis. Chapter 2 contains the background to help understand the world the individuals lived in, and chapter 3 covers the theoretical framework.

The second and third parts primarily pertain to the osteological part of the thesis. The second part is chapters 4 through 6. Chapter 4 and 5 explains the material and methods, respectively. Chapter 6 presents the results of my osteological analysis of the individuals from St. Nicholas Church and the London Blackfriars' data collected from WORD (2022). The third part is chapters 7 and 8. In chapter 7 I will discuss and compare the data from the two collections, and in chapter 8 the conclusion will be presented.

1.3 Ethical Assessment

In Norway an ethical assessment, and a description of your project, is needed when applying to work with human skeletal remains. The application must be approved by *Skjelettutvalget*, which is a part of *De nasjonale forskningsetiske komiteene* (FEK, *The Norwegian National Research Ethics Committees* (*on Human Remains,* Skjelettutvalget)). This project has been approved and the approval was published on their webpage the 6th of October 2021 (Skjelettutvalget 2021). I had seven main points in my ethical assessment following Sellevold (2012) and NESH's (*Den nasjonale forskningsetiske komité for samfunnsvitenskap og humaniora, The National Committee for Research Ethics in the Social Sciences and the Humanities*) ethical guidelines for research on human remains (2016).

There are nine guidelines from NESH (2016) for working with osteological remains, I have followed these guidelines while doing the osteological analyses for this project. The guidelines are: 1. Respect for the deceased, 2. Equal consideration regardless of origin, 3. Respect for descendants, 4. Respect of other groups, 5. Respect of the rarity of the material, 6. Assessment of the research project's feasibility and consequences, 7. Respect for other researchers, 8. Consideration of find context and provenance, and 9. The importance of complying with applicable laws and regulations and obtaining permits (Author's translation).

My seven points from the ethical assessment are:

1. None of the identities of the individuals from the collection are known, and thereby there are no known living descendants. There are no preserved church books with the

name of any members of the parish nor anyone buried in the cemetery, so it is not possible to track down anyone that could be a descendant of any of the individuals from the collection.

2. The graves are presumed to have belonged to St. Nicholas Church's cemetery based on their proximity to the cemetery excavated by Peter Blix in the 1870s as well as having the same orientation as the graves discovered by Blix. There does not exist any active congregation or parish today connected to the Medieval St. Nicholas Church, which seemingly was in use until the late 15th century. The remains do not originate from any existing cemetery, nor 'belong' to any existing organisation.
3. In the Middle Ages it was legal to dig up bones as long as there was no soft tissue associated with them, but the bones could not be removed from the cemetery (Olavsson 1914:32). The site is no longer a cemetery, and there are signs of it having been used as a garden after the Middle Ages. Based on Medieval law the ground does not qualify as holy ground any longer.

   Additionally, there is evidence that the bones that were dug up during the use of the cemetery were not reburied right away, and the handling of bones were not uncommon and might not have been seen as unethical from a Medieval perspective. This is especially the case with the Cult of Saints, where the remains of saints were kept and at times handled as relics.
4. Destructive analysis was not performed, and all material was handled carefully as to minimize the loss of material that can happen when it is handled. The analyses did not remove any material that can be useful for future research.
5. There is no known individual of Sami ethnicity in the collection. The individuals' ethnicities and origins are not relevant for the project and will not be further examined.
6. All findings and data are published in this thesis. Additionally, all of the data from St. Nicholas Church is also published on figshare.com (Schiøtz 2022a) to make sure of its availability.
7. The material is from a rescue excavation done by NIKU as part of the Follo Line project. And was excavated during 2014 to 2015.

2 Background

2.1 Medieval Europe

The European Medieval period lasted from c. AD 500 to 1500, and the start of the period was marked by the establishment of new states after the fall of Rome (Brégaint 2022). The period as a whole is associated with the spread of Christianity, feudalism, and the increase of power to kings, lords, and the Church. The consolidation of Church and state was common during the High Medieval period, which lasted from roughly AD 1000 to 1300, and the was a general economic and demographic growth (Brégaint 2022). The feudalist system brought with it a highly hierarchical structure of society. It had 'social estates' which had different legal and political privileges, these social estates were further separated into classes. An example of a social estate is the Church where different classes could be bishops, priests, lay brothers, and so on (Brégaint 2022: Rigby 2004:475, 503).

The period is also marked by violence and death. During the 8th century Western Europe was troubled with raids by the Pannonian Avars, the Moors, and the Vikings (Brégaint 2022). In Norway the Viking Age lasted until roughly AD 1050, which is when Norway fully entered the Medieval period. The end of the Viking Age is characterized by the Christianization of Norway, and the founding of the larger Norwegian towns also happened around this time (Bandlien 2022). The plague, also known as the Black Death, is estimated to have killed roughly 60% of Europe's population, going from a population of 75-80 million before the plague to 25-30 million after it (Frøland 2020:135). After the plague the Church's prestige and power was lowered, especially within the lower classes. Distrust and criticism of the Church paved the way for the reformation in 16th century which marked the end of the Medieval period (Brégaint 2022; Frøland 2020:142).

2.1.1 Transmission Through Trade

The trade routes of Medieval Europe appear to have been the main routes for transmission of pathologies across the continent. The studies done by Gómez and Verdú (2017), and Yue et al (2017), which both look at the spread of the Black Plague, are particularly relevant as both focus on how transmission worked in Europe in a contemporary period to this study. They look at the importance of trade routes when it comes to the spread of the plague, an importance noted in many studies, and also the importance of the size of settlements. Most studies finds that contagion was greater both to-and-from and within the larger settlements, in what can be called an 'urban mortality penalty' (Birchenall 2021:23, 27). The Late Medieval period saw the development of more long-distance maritime trade routes, as well as the already

established trade routes by land. These networks connected many of the major European cities (Yue et al. 2017:2). This period also saw the increased migration from rural to urban settings as there became a surplus of agricultural labour. The migrants often had fewer relevant skills for the urban work marked and ended with short- or very short-term employment. This could lead to the migrants living in so called 'working poverty' (Carocci 2011:387). The natives from the urban settlements developed an immunity to local pathologies during childhood, which the migrants had not. The increasing population of migrants thusly became yet another community for the pathogens to thrive in (Walter and DeWitte 2017:339, 345).

2.1.2 Miasma Theory and Medicine

Throughout time and across cultures the cause of disease has often been attributed to gods and/or spirits' dislike, and it was often thought that the person or community had angered them in some way (Karamanou et al. 2012:58; Mądra-Gackowska et al. 2018:1668). Medicine was believed to be a heavenly science, and that God created the medicinal herbs and plants to serve humans (Barnhouse 2018:97; Mądra-Gackowska et al. 2018:1670). And when medicine could not cure or fix the ailments they would turn to God through prayer and pilgrimage. Saints also offered a closeness to God that they believed could heal them or perform miracles (Holck 1986:11). Some saints were especially associated with curing the ill while they were alive, St. Hallvard, the patron saint of Oslo, is one of them (Nedkvitne and Norseng 2000:283-284).

Medieval medicine had stronger roots in beliefs rather than science, in the modern sense (Holck 1986:4-5). The core of their teachings were the miasma theory and the four humours. Miasma theory was the belief in some invisible substance in the air that caused diseases. This substance was associated with foul smells and is also referred to as 'bad air' (Jørgensen 2013:302). The miasmas were believed to originated in nature in unhealthy places with stagnate air, like marshes, while in towns it could come from filth and muck left to build up from sick people and their corpses (Ciecieznski 2013:92-94; Skålevåg 2020). The four humours are based on the belief that everything was made up of the four elements, this also reflected in the body. An imbalance of the humours was what caused sickness. The imbalances would be due to excess dryness or moisture, cold or heat. The treatment would often be to counter the imbalance, e.g., a cold sickness would be treated with a warm diet (Doțe and Georgescu 2019:70; Barnhouse 2018:102; Holck 2021)

The doctors sometimes had a smaller role in the Medieval period as many hospitals appear to have viewed them as nonessential (Barnhouse 2018:94-95). They were sometimes

only present for the diagnosis while the clergy and the (barber) surgeons did the work (Jáuregui 2018:89). The Council of Tours came in 1163 with the proclamation of '*Ecclesia abhorrent a sanguine*' ('the Church abhors blood' author's translation) making it illegal for the clergy to do the bloody work when it came to medicine. Per Holck (1986:6) writes that this meant that doctors could not do the bloody work, suggesting that only clergy were doctors. This proclamation created the divide between medicine and surgery which was present in Europe until the 19th century. Which created the profession of barber surgeon, a profession originating from the barber lay brother rather than the clergy doing the bloody work (Holck 1986:6). Common treatments such as bloodletting and pulling of teeth were seen as bloody work. Bloodletting often happened at an almost weekly basis at most hospitals, though there is no evidence of the belief of bloodborne pathology this was rather to balance the humours (Amundsen 1978:24; Jáuregui 2018:89, 96).

2.1.3 Medieval Sanitation

Despite how Medieval streets are commonly depicted as being covered in muck, filth, and dirt this was likely far from the truth. Streets would commonly be paved with planks, gravel, or stone (Jørgensen 2008:522). In Scandinavian harbour towns, like Oslo, planks were the most common as these could rest on pillars in the sand or clay. Due to the marine clay which Oslo was built upon a sturdy foundation would be needed to support stone structures and avoid then sinking into the ground (Jørgensen 2008:552; Stige and Bauer 2018:95). In London the streets were paved with stone (Jørgensen 2014:299). There are written source for how they did the street cleaning and maintenance, which is supported by archaeological evidence. Gutters were often situated in the middle of the street and householders were in charge of the street directly between their property and the gutter. From Oslo we have archaeological evidence of different type of planks and planks placed in different orientations in front of different tenement plots, making the streets into a quilt of different plank patterns (Jørgensen 2008:554-556).

In London the animal waste in the streets became a problem and led to water contamination. Clean water could be gathered from springs or wells; most springs however were at the edges of the city and most of the wells were private. If you did not have access to a well, and lived to far from the spring, you could use a suburban spring which likely were contaminated (Walter and DeWitte 2017:344). In Oslo it was required by law that tenement plots should have a well, or other access to clean water. Based on the number of excavated tenement plots with wells this law appears to have been followed (Nedkvitne and Norseng

2000:224). General waste should not be disposed of in the gutters, but in dunghills, waste pits, etc., commonly placed right outside of the settlement gates. Some larger towns and cities had dung carts to remove to waste from the settlement and to the disposal areas, similar to the modern rubbish trucks (Jørgensen 2008:562). From 1200s it was common in Scandinavian towns with using barrels as waste bins, this could have been to make it easier for the dung carts to collect the waste (Jørgensen 2008:563). The need to get the general waste out of the settlements could be due to the connection made between waste and the pathology-carrying odours the associated with miasmas (Jørgensen 2013:304).

2.2 Christianity and beliefs

2.2.1 The Use of Cemeteries

A Medieval cemetery had a much different role within society than what a cemetery has today. Cemeteries would be used as meeting grounds; it would also be used for discussing treaties and meeting between enemies (Gilchrist and Sloane 2005a:44-45). The church grounds and the cemeteries were protected, inviolable domains where bloodshed was not allowed. Eidsivatingloven §37 states that there should be no blood on the church grounds/cemetery (Olavsson 1914:23). Eidsivating was the court for the Hedmark, Oppland, and Romerike while Borgarting was the court that included Oslo (Sandvik 2017). It is however agreed that the surviving *kristenretten* (Christian law) would be the same or similar in the two courts as most of the laws overlap with other Christian laws from Medieval Europe (see Olavsson 1914). The spilling of blood in a cemetery would pollute it and it would also violate the church connected to the cemetery. The ground would no longer be holy and to again make it suitable for burials they would need to perform a ritual to re-consecrate the ground, and the person(s) responsible for the bloodshed would be punished (Gilchrist and Sloane 2005a:30-31). The punishment varied in different places and in Norway it was common with the payment of a fee (Olavsson 1914:23-24).

Other uses of cemeteries included social and economic activities and fairs and/or markets are known to have been held in England from the 11th century and on. This is backed by both written sources and archaeological evidence of coins and other artifacts that were not grave goods (Gilchrist and Sloane 2005a:31, 44-45). While fairs, markets, and other sanctioned activities were accepted, a late 14th century account of an accusation against the church

treasurer allowing workmen to use the cemetery for storage and workplace, and animals entering the cemetery shows non-acceptable activities (Gilchrist and Sloane 2005a:44).

2.2.2 Charnels

Charnels are the tradition of storing disarticulated bones in charnel houses or pits, sometimes also called bone pits. The bones in charnels were commonly exhumed by accident when a new grave was dug. The bones had to be free of any soft tissue, if there still were any soft tissue the cadaver would be left in peace and the grave would be dug elsewhere (Gilchrist and Sloane 2005a:194). Eidsivatingloven §50 states that they could not move bodies which still had skin and hair, in the same section it is also stated who could and could not be buried in the cemeteries, where people could be buried based on their status, and that bones are not to be removed from the cemetery (Olavsson 1914:32-33). Charnel pits can also be placed within a grave. There can also be the reintegration of disarticulated bones in a grave which cut through a pre-existing grave whilst being dug. The bones in both charnel houses and pits often show signs of not being immediately stored, but rather that they had been exposed to the elements for some time before they were stored (Gilchrist and Sloane 2005a:30, 51, 195).

2.3 Medieval Oslo

2.3.1 The Establishing and Development of the Town

The date of Oslo's founding is highly discussed, but AD 1050 is commonly used as the founding year (Brendalsmo and Molaug 2014:137). Oslo's size and importance grew from the 11th century until its height in the 14th century with a population between 2,700 to 3,300 people and it covered roughly 23 hectares (Derrick 2018:30; Nedkvitne and Norseng 2000:179). Even though this increasing urbanization happened other placed in Norway as well it is still small in the larger picture. During this period roughly 20% of England's population and 10% of Scotland's population lived in town, while in Norway no more than 5% of the population lived in towns (Iversen 2015:245).

Oslo had at the most five churches, three monasteries, and three hospitals, one of which appears to have been a leper hospital (Bauer 2020:255-256). The leper hospital was St. George (St. Jørgen), but it is uncertain whether or not a church belonged to the hospital. St. George's hospital was outside of the Medieval town, following the pan-European custom of keeping the hospitals away from the healthy but easily accessible (Brendalsmo and Molaug 2004:167-169; Holck 1986:12; Riksantikvaren 2015:17-18). Life was harder and shorter; the life expectancy

was between 20 and 40 years due to high rates of child mortality. The average age from St. Nicholas Church's cemetery, based on both *in situ* and *ex situ* individuals, was 24.8 years. But excluding the juveniles the average age of the adults were 37.3 years. The average age of the sexes were 36.8 years for females and 43.6 years for males, showing that child mortality and complications due to labour greatly affected the life expectancy in the Middle Ages (Holck 1986:8; Jensen 2018:36-37).

2.3.2 The life in Oslo

People lived in tenement plots (*bygårder* in Norwegian), a tenement plot is a '*group of houses with common gate and courtyard. The number of houses and size of plot could vary*' (Nedkvitne and Norseng 2000:204-205, Author's translation). These often housed 1 or 2 households, each household would be around four people though it is likely that they had permanent lodgers as well. When there were multiple households in one tenement plot there would not be any clear boarder between the two, and they would share a common toilet and well (Nedkvitne and Norseng 2000:204-207). The private wells would lessen contamination of the water for the whole town and each tenement plot would be in charge of keeping their own water clean. It was also common with brewing equipment per tenement plot, and there is found evidence of hops associated with brewing from Oslo. The boiling during the brewing process and the alcohol would make it more sterile than just water would be (Nedkvitne and Norseng 2000:224-225; Schia 1982:157). Christianity brought with it restrictions and regulations surrounding food and diet. Though it appears that people in Medieval Oslo continued with the same diets as before Christianity, putting up resistance against the change. A change towards the Christian eating regiment would likely shown as a higher number of dietary deficiencies among the children, this could be why Oslo has a lower number of these than most of the contemporary European towns (Naumann 2020:222-226)

The living area in the Norwegian tenement plots were 70-80 m^2 per household. This was roomy as many European towns had less living space, in France 30-40 m^2 was common (Nedkvitne and Norseng 2000:208). Though archaeological evidence indicates that during the Late Medieval period the buildings were quite cramped within the tenement plots (Schia 1982:151). The living room and the bedroom would be on the top floor of the buildings. Where there would also be a fireplace, making it the warmest and driest floor. Everyone would share the bedroom, and often they would share the same bed (Nedkvitne and Norseng 2000:206-207). It was common for people to lodged with families in the tenement plots. It is possible that thousands of people lodged in Oslo within the duration of one year. The lodgers were

mainly farmers from the country that would come to town to sell their wares, or they would send their children to go to school in town. Lodgers could also be foreign merchants, crafters, and immigrants, though Oslo had few foreigners compared to the other Norwegian merchant towns. The town law stated that foreign merchants had to be lodged before they could start selling their wares (Nedkvitne and Norseng 2000: 276-277).

The town as a whole would try to help households that struggled economically. However, if their problems became too much to manage, the household and its problems would be split amongst their heirs who would then be in charge of their wellbeing (Nedkvitne and Norseng 2000:228). Having poor family members was viewed as shameful so even distant relatives would help whichever way they could. Though in some cases there would be no family nor heirs that could help out and for this Oslo had a 'legd-system' (Nedkvitne and Norseng 2000:219-220). This system was for the poor, though the poor does not simply refer to the ones without a job but also the disabled, orphans, elderly, and sick without anyone to take care of them (Nedkvitne and Norseng 2000:229). The legd-system was organized by the church and the people, and not the government (Nedkvitne and Norseng 2000:231). The poor partaking in the legd-system would go from tenement plot to tenement plot where the households would have to take care of them, give them food and a roof over their head. The ones that could not walk would be carried. The poor would also be handed alms from the church, the alms would be donated to the church from its patrons. Begging was not allowed in the town (Nedkvitne and Norseng 2000:228). The inhabitant from the leper hospital did not partake in the legd-system due to contagion. The hospital, as other leper hospitals, seem to have the purpose of protecting the healthy rather than curing the ill. The sick and disabled that partook in the legd-system was likely not viewed as contagious in the same way as the lepers and therefore were kept out of the hospital (Nedkvitne and Norseng 2000:229).

2.3.3 St. Nicholas Church

St. Nicholas Church is one of the smallest, if not the smallest, of the Medieval churches in Oslo, it is also the Medieval church in Oslo which we known the least about (Derrick 2018: 183). The church itself has been 'lost' after its excavation in the late 1870s, it is referred to as 'lost' as the ruins were removed and what happened to them is unknown. The ruins of the church were first encountered during the construction of the Smaalensbanen railroad and was excavated by Peter Blix from 1877-79 (Derrick 2018:33). When the ruins were discovered, they were originally thought to be the St. Clement Church (Clemenskirken). St. Clement Church however was excavated in the 1920s and further studies of written sources showed that

the placements of the churches fit better with the one found in the 1870s being St. Nicholas Church and the one found in the 1920s being St. Clement Church (Fischer 1950:92; Norseng 1986:16). St. Clement Church has Oslo's oldest known Christian cemetery, which is radiocarbon dated to the early 11th century. The church was demolished in AD 1540 (Derrick 2018:31).

After the 1870s excavation it was assumed that the entire cemetery was discovered and that all the graves were removed, this turned out not to be the case (Jensen 2018:15). From the middle of July 2014 to April 2015 NIKU excavated 165 m^2 more of the cemetery south and southeast of the originally excavated area. There was also registered five visible *in situ* graves and one empty grave in the eastern limits of the excavation, which were not excavated. This implies that the cemetery could be even larger (Jensen 2018:18-20). The area excavated by NIKU had a predominance of females and infants and it is possible that this area of the cemetery was originally reserved for women and children. It was common in Medieval cemeteries that the men were buried apart from the women and children. Though due to the small sample it is hard to discern if the cemetery was divided into an area for the men and another for women and children (Derrick 2018:194-196).

The exact number of individuals excavated from St. Nicholas Church's cemetery by Blix is uncertain. In 1879 Blix wrote that 73 crania were collected from the area south of St. Nicholas Church (Jensen 2018:55). On a phone call Anne Østegaard Jensen (2018:55) had with Per Holck, who was then in charge of DSS, on 8.11.2017. Holck stated that they had roughly 1,000 crania that had been collected during the 1877-79 construction of Smaalensbanen which could have belonged to St. Nicholas Church. As this was before the excavation of the St. Clement Church it is hard to know which of the churches they might have belonged to due to the proximity of the two churches and their cemeteries. Derrick (2018:200) suggests that due to the increasing population the two cemeteries might have merged during the late 13th to early 14th century. During an excavation done by NIKU (NIKU oppdragsrapport 132/2016) from December 2016 to January 2017 it was discovered two redepositions of human bones at Loenga with a MNI (minimum number of individuals) of 215. It is possible that the bones belonged to St. Nicholas Church and was redeposited during the work on Smaalensbanen (Jensen 2018:55).

Blix dated the stone church that he found to around AD 1300 but based on written sources St. Nicholas Church was older (Derrick 2018:33). The first mention of St. Nicholas Church is from Håkon Håkonsson's saga in 1240, it is possible that this was an earlier version

of the church made of timber (Brendalsmo and Molaug 2014:166; Derrick 2018:182). In Håkon Håkonsson's saga there is also mentioned the 'moving' of a fortress to St. Nicholas Church, this was likely synonymous for the fortress being dismantled and the stones being used for St. Nicholas Church or some nearby structure (Brendalsmo and Molaug 2014:180-181). This happens later in the saga than the first mention of the church and it is possible that this refers to the construction of the church Blix excavated. The last reference to St. Nicholas Church is in *diploammaterialet* in a letter from the 1460s (Norseng 1986:23). There is a general pan-European pattern of decline of monastic cemeteries after the mid-15th century due to decreased population numbers after the plague (Gilchrist and Sloane 2005a:54). The dates of the graves excavated by NIKU show a period of use of the cemetery from between the 2nd quarter of 13th century to the early 15th century (Derrick 2018:182, 194). The archaeological dating of the graves and the written sources' dates coincide.

Despite St. Nicholas Church's small size and proximity to the much more important St. Clement Church it is assumed that St. Nicholas Church was a parish church (Brendalsmo and Molaug 2014:165). In High Medieval Oslo the town was divided into two main parishes, St. Clement Church was the parish in the south while the Holy Cross Church (Korskirken) was the parish in the north. A letter which Nedkvitne and Nordseng (2000:60) dates to 1297, however it could date up to the late 15th century, indicates that St. Nicholas Church had parish in Brekkelaget. It is also possible that St. Nicholas Church's parish covered the area from Ekeberg and all the way south to '*herredsgrensen'* ('county boarder', author's translation) (Jensen 2018:15).

2.4 London Blackfriars

London was founded in AD 43 by the Romans, then as Londinium, and by the start of the Medieval period it was the largest city in Europe north of the alps. During the 3rd century AD the Roman settlement was roughly 135 hectares, while around 1200 the city with its surrounding suburbs were roughly 275 hectares (Hebbert et al. 2022). London had roughly 30,000 inhabitants at this point, but this number almost tripled during the next 100 years and in 1300 the population was of roughly 80,000 inhabitants, with some even suggesting it was as much as 100,000 inhabitants. The majority of the population still lived within the original Roman walls (Hebbert et al. 2022; Jørgensen 2014:226). Medieval London was an important trade centre with merchants from many European countries established within the city, this

included Danish, German, Gascon, Flemish, and northern Italian merchants (Hebbert et el. 2022). Though a large city would not only attract trade and prosperity, but it would also attract poor people, who often also had poor health. Combined with the population density and trade larger cities tend to be more exposed to epidemic (Walter and DeWitte 2017:339).

The Dominican Friary of London was founded in 1221 on the south side of Holborn. In 1275 they obtained a licence from the King for the new Dominican Friary, the new site was between Ludgate and the Thames placing it by the very western edge of the Roman city (Gavin 1990[1988]:5; Watson 1990:47). It is not known whether or not the cemetery predates the Friary, the earliest burials are not documented, and it is hard to date the graves based on limited finds. Stratigraphically the cemetery is dated to 1200 or later, and no radiocarbon (^{14}C) dating has been done on the skeletons. There is documentary evidence that the cemetery was in use right until the closing of the Friary in 1538. The construction of a cellar in the eastern part of the cemetery from the second half of the 16th century also supports this (Watson 1990:48, 53-54).

The full extent of the cemetery is uncertain. There was an excavation from 1986 which limits it to the east, with no graves or residual human bones (Watson 1990:49). The 1988-1987 excavations limit it to the north as there are no known burials north of the excavations. The western limits however are uncertain, while there is a decline grave density there is also modern destruction of this part of the cemetery which could have destroyed evidence of graves. The western limits might have been found as a shallow V-ditch, which was discovered during the WAY83 excavation under 12/13 Ludgate Broadway excavated in 1983. The church itself was to the south of the cemetery (Gavin 1990[1988]:5; Watson 1990:49). There are recovered 58 individuals from the cemetery, 13 of which were found in one mass burial. Six of the individuals from the mass burial were juveniles, of the seven adults there were three males, two females, and two unsexed individuals (Watson 1990:52). The mass burial both includes the only non-supine individual and the only individual with evidence of clothing from the cemetery. The individuals in the mass burials overlap each other and Gavin (1990[1988]:99) describe them as appearing to have been '*crammed*' into the available space. All the findings from the mass burial suggest that it was done in a hurry, and it interpreted that the individuals were victims of an epidemic (Gavin 1990[1988]:99; Watson 1990: 61-62).

3 Theory

The theoretical framework of this thesis is covered in this chapter. Joanna Soafer's (2006) book *The Body as Material Culture* explains the importance of theory in an osteological study. In the book she looks at the common misunderstanding as osteology as atheoretical and explains how the human body should be understood as materials culture on equal lines with any other artifact from an archaeological site. Additionally, an understanding of the core concepts of the osteological paradox is essential when doing an osteological analysis.

3.1 Body as Material Culture

Osteology and social theory are often seen incompatible, likely stemming from osteology being seen as a purely scientific thereby atheoretical. But we cannot use an empiricist view and analyse the osteological data void of theory and assume that the data can give the answers alone (Sofaer 2006:xiii, 10-11, 31-2). Without the context of the socio-cultural relation of the society the body belonged to the data is useless. Sofaer (2006) means that bodies are as much material culture as any artifact from a site and that the body's materiality places it '*within the sphere of archaeological investigation'* (Sofaer 2006:xv). Much of archaeology's theoretical framework fails to incorporate the archaeological evidence of the physical body (Sofaer 2006:10, 40). The human existence is split between two disciplines within archaeology: osteology examining the scientific, physical body and the interpretative archaeology theorizing about the social body. Mirroring the Cartesian split of the body and the mind (Sofaer 2006:1-2, 42-43, 50).

The body sometimes receive treatment much the same as an object when it is alive. The commoditization of the living body can be seen throughout history, the selling of people into slavery, women being treated as their male guardian's property, and prostitution. There are also many jobs where the employees offer services or labour in a way that makes the people the product the job offers (Sofaer 2006:64). The dead body has also historically been treated as an object, e.g., 16th and 17th century body snatching and selling of bodies to anatomy labs and the Medieval tradition of relics. There are even examples of consumption and sale of human remain, which have mainly been for medical reasons (Sofaer 2006:64). A common form of consumption was 'mummy elixirs' made from ground up mummies that were common enough as to be stored by many apothecaries during the 17th and 18th century (Roach 2003:222-224). The commodification of the human body highlights its material foundation (Sofaer 2006: 64).

The body is created within and by a material world, and like all other objects it is shaped by it. The antemortem social and environmental treatments of the body, as well as a person's

health and genetics shape it while living in a way associated with culture rather than nature (Sofaer 2006:xv, 57; Zuckerman and Crandall 2019:161). Musculoskeletal activity markers shape the skeleton by repeated actions, often associated with labour. Cultural traditions of body manipulation, like the Chinese tradition of foot binding, are also examples of how the body is shaped by the world it lives in. In modern times we can see the way people shape their bodies with plastic surgery and biohacking, or people permanently decorate their bodies with tattoos and piercings much like one can do with an object (Sofaer 2006:xv, 57, 105, Zuckerman and Crandall 2019:163). Sofaer choose not to cover taphonomic processes but specifies that '*there are strong arguments that can be made to view post-mortem processes in terms of material culture' (*Sofaer 2006:xv). These post-mortem processes include social and environmental treatments of the body that shape it, be it the social and cultural rituals surrounding death, taphonomic process, or even cannibalism as mentioned above There are great archaeological advantages of seeing the body as material culture similar to how we see an artifact. Theory and other methods more commonly used on material culture can be used and it can be a more important foci in the archaeological investigation (Sofaer 2006:88).

3.2 The Osteological Paradox

Wood et al. (1992) was the first to propose the osteological paradox which is essential for interpreting skeletal material. It centres around two important concepts; hidden heterogeneity and selective mortality (Wood et al. 1992:344). The term 'frailty' is relevant for both concepts, though more so with hidden heterogeneity. Frailty is generally defined as '*an individual's relative risk of death compared to a standardized cohort risk*' (Wood et al. 1992:345). Differences in frailty within a population is common and factors as to why include differences in the individual's immune response, risk-taking behaviour, and exposure to hazards, be it occupational or environmental (Buikstra 2019:16).

Hidden heterogeneity is this heterogeneous frailty within a population, various subpopulations within a population could be the reason for this (Wood et al. 1992:348). Wood et al. (1992:345) uses the example of how three different groups show different response to the same stress. Group 1 does not experience the stress, group 2 is exposed to the stress over a longer period of time and has many survivors, while group 3 is exposed to the stress and dies off rapidly. Group 2 develop skeletal lesions as a result of the prolonged exposure to the stress, while group 3 dies off too fast to develop any skeletal lesions. In the skeletal record it will only look like two groups, the 'healthy' without any lesions and the 'unhealthy' with lesions. In reality the 'unhealthy' group is the only that survived prolonged exposure to the stress. The

'healthy' group is made up of the ones that did not experience the stress (group 1) and the ones exposed to the stress that died of rapidly (group 3).

Selective mortality refers to the fact that the number of individuals that were sick or at the risk of death at a certain age is not necessarily known, only when they died (1992:344). An individual might develop lesion during a period of their life with a heightened risk of death but survive it and die at a later age. This results in a high selectivity within a sample of an age group when it comes to lesions associated with risk of death at that age. In other words, the individuals with skeletal lesions are often the ones that survived the original stress. It is therefore important to note whether or not a lesion was active or inactive, as the inactive lesions indicate that the individual survived the original stress (Wood et al. 1992:345, 352).

Individuals with lesions might be healthier than the ones without any, as seen in the example with the three groups. A healthy individual would survive pathologies that a frailer individual would not, and thereby they would develop skeletal lesions while the frailer individual did not. So, a lack of skeletal lesions may not equate to good health, nor may skeletal lesions equate to good health (Buikstra 2019:17; Wood et al. 1992:352). As Wood et al. (1992:356) put it '*better health makes for worse skeletons*'.

The absence of a pathology within a population cannot solely be based on the lack of skeletal lesions associated with said pathology. Only a fraction of individuals develops skeletal lesions when they develop a pathology, this could lead to the underestimation of a pathology's prevalence within a population (Wood et al. 1992:344, 365). At the same time, the skeletal lesions are likely higher in the dead age group than in the living counterparts as the frailer individuals are more likely to die. Resulting in an uneven representation of the population at the given age, which might lead to the overestimation of the pathology's prevalence. Though these two do not necessarily cancel each other out (Wood et al. 1992:346, 350). Similarly, the lack of skeletal lesions associated with a pathology does not mean that the pathology was not widespread within the population. An example is lepra, where skeletal involvement is quite rare (see section 4.1.1.2 of this thesis). A lack of lesions associated with lepra does not mean that there were no lepers within the population, rather that no one had skeletal involvement. Lepra might still have been widespread. Likewise, a population where 10% had skeletal involvement associated with lepra does not mean that lepra was widespread, it is possible that only those 10% had lepra (Wood et al. 1992:365).

4 Materials

4.1 Pathology introduction

4.1.1 Infectious

Infectious pathologies are caused by bacteria, viruses, fungi, and parasites, with bacteria being the most common cause. How an individual is affected depends on their immune response, though age, sex, social status, nutrition, and genetic heredity are also common factors (Buikstra 2019:285, 321; Roberts and Manchester 2010:167). An individual's immune response is created during their childhood by exposure to microbes and a healthy, balanced diet (Buikstra 2019: 285-286). Poor health in an individual's earlier years is like to carry over as poorer health in their adulthood. As the immune response is developing during childhood children, especially infants, are more exposed to infections which most probably played a large role in the child mortality rate in the past (Buikstra 2019:287; Roberts and Manchester 2010: 165, 223).

Infectious pathologies are however likely underrepresented in the archaeological record compared to how widespread they were. Many of the deadly ones causes death too fast to leave any trace on the skeleton, e.g., the plague, appendicitis, pneumonia, and meningitis. And many only affect the soft tissue, like influenza. The ones seen in the archaeological record are the ones that are subacute and chronic, and they might not have caused death (Buikstra 2019:287; Roberts and Manchester 2010:167).

4.1.1.1 Tuberculosis

Tuberculosis (TB) is seen as an urban pathology and it is often associated with urbanization, as high population density greatly increases the spread of the pathology (Roberts and Manchester 2010:186). It is caused by the bacteria species of the *Mycobacterium tuberculosis* complex, of which the *M. tuberculosis* and *M. bovis* strains are the most common in humans. *M. tuberculosis* mainly transmit between humans while *M. bovis* is transmit between cattle and humans. Both can be transmitted via droplets, though *M. bovis* also transmits via the ingestion of infected milk and meat products (ADBOU 2015:34; Buikstra 2019:321; Roberts and Manchester 2010:184-187). Working directly with animals and their by-products increases the risk of infection from *M. bovis* (Buikstra 2019:351; Roberts and Manchester 2010:185).

TB occurs either primary or secondary. Secondary is caused by either a reinfection or the re-emergence of a latent infection and it is usually only in this form that there is skeletal

involvement. Assumably 3-5% of the cases develop skeletal involvement, the number is based on modern clinical studies (Buikstra 2019:322-323; Roberts and Manchester 2010:187-188). The most affected bones are the hips, knees, and the vertebrae. Vertebral TB, also known as Pott's disease, is the most common type and is characterized by the collapse of the centrum of one or more vertebrae which can lead to a kyphotic deformity (Buikstra 2019:327-343; Roberts and Manchester 2010:187-190).

Figure 4.1 *SZ20347's sacrum, posterior aspect. Inside the red circles are the bone loss associated with tuberculosis. Photographed with a 10cm*10cm photo scale*
Photo by Sara Georgine Fløien Schiøtz

While it is rare isolated sacral TB can occur, and it is scantly represented both in modern medical literature and in osteological and palaeopathological literature. The skeletal involvement is most commonly seen in adults while in children it mainly affects the soft tissue (Patankar et al. 2000:392-395). In Patankar et al.'s (2000) clinical study the majority of their cases are under 40 years old. Suzuki (1985) compared the changes in the lumbosacral region of an archaeological female and a modern autopsied male with tuberculosis, who died in 1952, and found that the typical bone changes are '*chronic inflammative osteolytic destructions with little new bone formation and various sized round-shape abscess formation*' (Suzuki 1985:385). It is shown an example of sacral TB in Figure 4.1.

4.1.1.2 Lepra

Like TB leprae is caused by a bacterium from the *Mycobacterium* genus, *M. leprae* (ADBOU 2015:27; Buikstra 2019:363; Roberts and Manchester 2010:194). Though in contrast to TB it is seen as a more rural pathology which saw an increase in urban centres due to trade and migration. It transmits via droplets, but it has also been suggested that it could infect via skin contact (ADBOU 2015:27; Buikstra 2019:364; Roberts and Manchester 2010:194, 202). Less than half the people exposed to the pathogen develop the pathology. It has an incubation period of 2-5 years, with a slow progress due to the slow multiplication of the bacteria. It is

often likely acquired during childhood but only show symptoms during adolescence and early adulthood (Buikstra 2019:364; Roberts and Manchester 2010:194).

Skeletal involvement is believed to happen in 3-5% of cases, and the effects manifest varied in severity, infectivity, and bodily distribution based on the individual's immune response (Buikstra 2019:364-365; Roberts and Manchester 2010:195). The severity of lepra is often seen as a scale with lepromatous lepra being the most severe and tuberculoid lepra being the least severe. Both can cause skeletal involvement; however, it is more common in lepromatous lepra which also is the more contagious type (Buikstra 2019:364-365; Roberts and Manchester 2010:195). The main areas that are affected are the face and the peripheral, like the hands and feet, though the tibia, fibula, ulna, and radius are also commonly affected. The involvement of the nasal and palate bones (Rhinomaxillary syndrome, RMS) is due to the infection of the nose and mouth and only occur in lepromatous lepra (ADBOU 2015:27; Buikstra 2019:363-367; Roberts and Manchester 2010:195-198). Due to the loss of feeling in the peripheral trauma is less likely noticed in these parts of the body and thereby being left untreated. This can cause secondary infection and secondary periostitis. This commonly occur in the hands and feet and can spread to the ulna and radius and the tibia and fibula respectively (Buikstra 2019:366-367, 374; Roberts and Manchester 2010:196-197).

4.1.1.3 Periostitis

Periostitis is an inflammation in the periosteum due to an infection. It causes formation of new bone after 'damage' to the periosteum: starting out as fine pitting and longitudinal striation and ends up as a '*plaque-like new bone formation on the original cortical surface*' (Roberts and Manchester 2010: 172). Trauma, stress, or ulcers can be the cause of the infection, and likely make up the majority of cases in archaeology. The most commonly affected bone is the tibial diaphysis, due to its closeness to the skin and thereby likelihood of recurrent injury (Buikstra 2019:292; Roberts and Manchester 2010:172). Periostitis can occur both primary and secondary, primary is when a it is not associated with a specific diagnosis while secondary is part of another diagnosis, as with secondary periostitis in lepra (Buikstra 2019:287-288; Roberts and Manchester 2010:172).

4.1.2 Joints

Joint pathologies usually make up roughly one-third of pathologies and are the most common condition seen in human remains (Buikstra 2019:719; Roberts and Manchester

2010:134). They are caused by the continued use of a joint after the destruction of the cartilage, and can lead to eburnation of the joint surface, this is the second stage. The first stage, usually, only involve the cartilage and is not visible in the archaeological record. They can be separated into two groups whether bone formation or bone loss is predominant (Buikstra 2019:719; Roberts and Manchester 2010:133-135).

4.1.2.1 Osteoarthritis

Osteoarthritis (OA) is the most common non-inflammatory pathology of the synovial joints (Buikstra 2019:719-721; Roberts and Manchester 2010:136). The earlier stages with skeletal involvement only have minor abrasions, later developing eburnation, sclerotic bone formation, osteophytes, and/or heightened porosity. In the more sever stages the involvement will be greater and the osteophytes larger, sometimes resulting in ankylosis of the joint(s) (Buikstra 2019:719-721). The weightbearing joints (hips and knees) as well as the spine are the most commonly affected, and they are all associated with the human bipedal posture (Roberts and Manchester 2010:138-139). Most of the times the progress is slow, though in secondary osteoarthritis the break-down of the cartilage is speed up by another pathology or trauma thereby speeding up the bone changes. Secondary osteoarthritis occurs earlier in life than primary osteoarthritis, which is the most common. While age, trauma, and movement on the joint are the most common factors other factors include obesity and genetic predisposition (Buikstra 2019:719-724; Roberts and Manchester 2010:136-138).

4.1.2.2 Ankylosis

Ankylosis is a fibrous fixation of a joint which causes the joint to stiffen or be immobilized. It usually occurs secondary to another pathology, like osteoarthritis. It can also occur primary when no clear condition is causing it (Roberts and Manchester 2010:188; White and Folkens 2005:419).

4.1.2.3 Diffuse Idiopathic Skeletal Hyperostosis (DISH)

Diffuse idiopathic skeletal hyperostosis, commonly known as DISH, is a pathology affecting the spine with a characteristic look of ‘dripping candle wax’ which is caused by the ossification of the anterior longitudinal ligaments of the spine and paraspinal tissue (Buikstra 2019:730; Roberts and Manchester 2010:159). A minimum of four consecutive vertebrae has to be fused for it to be diagnosed as DISH. It only affects the right side, with some exceptions, this is assumed to be due to the presence of the aorta on the left side somehow preventing ossification (ADBOU 2015:23; Buikstra 2019:730; Roberts and Manchester 2010:159-160).

The exact aetiology is unknown, but it is associated with obesity and type 2 diabetes, though there has been suggested that there is a genetic factor as well. In the Medieval period it is more common from high-status individuals, for instance those who were buried in monasteries. This is assumed to be due to the monks' rich diet and lack of mobility increasing their chances for obesity and type 2 diabetes (ADBOU 2015:23; Buikstra 2019:731; Roberts and Manchester 2010:159-161).

4.1.3 Circulatory and Metabolic

Circulatory conditions are caused by disturbances to the blood supply to a bone due to a variation of aetiologies, these can be trauma, infections, genetic, or other pathologies (Buikstra 2019:491; White and Folkens 2005:320). Metabolic conditions' causes include nutritional problems and hormonal imbalances, and for the most part they can be described as indicators of stress. How an individual reacts to the stress depends on their immune status and their genetic predisposition (Buikstra 2019:531; Roberts and Manchester 2010:222). There has also been suggested that psychological stress can be a factor for metabolic conditions (Roberts and Manchester 2010:222).

4.1.3.1 Freiberg's disease

Frieberg's disease affects the metatarsal heads, and almost all cases are of the second metatarsal which receives most of the stress and pressure as it is the longest metatarsal (Buikstra 2019:500). The stress as well as trauma are the two most common causes. As a result, the metatarsal is shortened with a transversally broader head, and it is common with necrotic collapse of the cartilage and subchondral bone which can cause the metaphysis and the diaphysis to become abnormally large (Buikstra 2019:500).

4.1.3.2 Osteochondritis Dissecans

Trauma is the major aetiological factor for osteochondritis dissecans and is therefore under chapter 5 'Trauma' in Roberts and Manchester (2010). It includes the disturbance of the blood supply to the bone and fragmentation or collapse of part of the joint: the cartilage and often the subchondral bone. It causes a small sequestrum of bone, which in some cases separates and becomes a loose osseocartilaginous body in the joint. It affects the knee joint in 80% of cases, most commonly on the laterally part of the articulating surface of the *condyles medialis femoris* (Buikstra 2019:500; Roberts and Manchester 2010:121).

4.1.3.3 Cribra Orbitalia

Cribra orbitalia (CO) is often included with porotic hyperostosis (PH) as they are commonly accepted as the same condition affecting different parts of the cranium; PH mainly affects the cranial vault and CO affects the orbit (Buikstra 2019:515; Buikstra and Ubelaker 1994:112). CO, and PH, causes thinning or destruction of the outer table of the bone leaving lesions with a porous, almost sieve-like look (White and Folkens 2005:320). CO is not necessarily connected with just one aetiology, though it is commonly seen as indicative of anaemia, other possible causes include localized inflammation, or the presence of rickets or scurvy, though some bone neoplasms can be confused with CO (Buikstra 2019:514-516; Roberts and Manchester 210:230-231). The development of skeletal involvement with CO, and PH, more often occur during childhood or early adulthood. CO can be present for the rest of an individual's life even after the lesion has become inactive (Wood et al. 1992:350).

4.1.3.4 Osteoporosis

Osteoporosis causes bone loss or a decline in microstructural integrity of the bones (Buikstra 2019:531). Usually caused by the thinning of the cortical bone, thinning and loss of trabecular bone, and increased porosity. It weakens the skeleton, increasing the risk of fractures and subsequent complications (Buikstra 20119:553; Roberts and Manchester 2010:242). The most common fractures associated with osteoporosis are Colle's fracture of the wrist, the fracture of the *collum femoris*, and compression fracture of the vertebrae. These fractures can be used when making a diagnosis (Roberts and Manchester 2010:244). Advanced age is a common factor as bone mass reaches its peak during early adulthood and it naturally starts to decline from middle-age and on. It is associated with hormonal changes and is common in post-menopausal females. It can also occur secondary to other pathologies and immobilization (Buikstra 2019:531, 552-553; Roberts and Manchester 2010:243). The techniques and tools commonly used for diagnosing include dual-energy X-ray absorptiometry, radiographic or other imaging, microscopy, and chemical analysis, as well as some non-invasive technique (Buikstra 2019:555). None of these tools and/or techniques were available for this study. Two individuals (SZ19834, female aged 60-80 years, and SZ20283, possible female aged 40-50 years) had compression fractures, none of the other individuals had any of the common fractures.

4.1.4 Congenital

Congenital conditions are developmental defects which is caused by disruption during the foetal development. They can affect soft tissue and/or the skeleton and vary from being asymptomatic to fatal, as the child sometimes do not survive for long after birth. The fatal ones often affect organs, though there are fatal skeletal defects as well (e.g., anencephaly) (Buikstra 2019:585; Roberts and Manchester 2010:44). Children with congenital conditions likely had a greater mortality rate in the past than the 'normal' children, though they might not have died from the defects. Their immune systems were likely weakened, making them more susceptible towards infectious pathologies. Modern clinical studies show that as developmental defects are due to disruption at a stage in the foetal development it is common with a second, or more, defect(s) that would have developed at the same stage (Roberts and Manchester 2010:45-46).

4.1.4.1 Bathrocephaly

Bathrocephaly is a normal variation of the skull shape caused by a deformity of the occipital bone. An incomplete fusion or a failure to fuse of the mendosal suture is the cause, which usually start to fuse *in utero* and finishes during the first years after birth (Davanzo et al. 2014:263-266). The mendosal suture is the suture between the interparietal and the inferior portions of the occipital bone and the deformity causes the occipital to take on an elongated, bulbous look. Most cases have no underlying cranial pathology, but it can be caused by the premature closure of other sutures such as the lambdoid can be the cause. This commonly only affects children as the remodelling of the skull usually 'fixes' the deformity, in some cases however it persists into adulthood (Davanzo et al. 2014:263-266; Neto and Bell 2021).

4.1.4.2 Spondylolysis

Spondylolysis is a condition where the neural arch separates from the rest of centrum, usually due to a (stress) fracture at the *pars interarticularis*. This is technically a fracture; however, it is commonly due to a disturbance of the bone development making it more susceptible to

Figure 4.2 *L4 (left) and L5 (right) from SZ25196 with spondylolysis. The neural arches and the centra are placed as to show the spondylolysis. Both vertebrae have healed non-union fractures. Photographed with a 10cm*10cm photo scale. Photo by Sara Georgine Fløien Schiøtz*

fracture (Buikstra 2019:599, 730; Roberts and Manchester 2010:57, 106). It most commonly affects the L5 followed by the L4, but it can occur in other vertebrae as well. While it can heal, it commonly does not and results in a non-union fracture, only held together by ligaments and fibrous tissue (Buikstra 2019: 600-603, 730; Roberts and Manchester 2010:57, 106). Figure 4.2 shows spondylolysis of both L4 and L5, while both were non-union where the neural arches would have 'articulated' with the centra is still visible. This is clearest on L4's right side. It is mostly asymptomatic, but the vertebral body can slip forward (spondylolisthesis) causing complications (Buikstra 2019:599; Roberts and Manchester 2010:107).

4.1.5 Neoplastic

Neoplasms are uncontrolled, abnormal masses of tissue that do no longer follow the strict pathways of the cell, which in the skeleton either disrupts the resorption or formation of the bone (Buikstra 2019:639; Roberts and Manchester 2010:252). They are either benign or malignant, though technically some fit in neither category. The benign ones remain localize and only spread localized. The malignant neoplasms encompass the ones known as cancer. They spread uncontrolled from their primary growth and can spread to other organs and even 'move' through the body via the blood stream or lymphatic canals (Buikstra 2019:639; Roberts and Manchester 2010:252-253). Bone neoplasms are rare compared to other neoplasms. Primary bone neoplasms that originate on or in bone, are more likely benign than malignant (Buikstra 2019:640; Roberts and Manchester 2010:254).

4.1.5.1 Osteoma

Osteomas are benign neoplasms of unknown aetiology and can be compact or ivory osteomas, cancellous or mature osteomas, or a combination of the two (Buikstra 2019:648; Roberts and Manchester 2010:253). The most common type is ivory osteomas, also known as button osteomas, which are a common find in archaeology. They are made up of dense, mature lamellar bone and are usually found on either the cranial vault or the mandible, most commonly on the parietal and frontal bones. They are usually 2-4 cm in size, smooth, and round. They commonly appear solitarily and are symptomless (Buikstra 2019:648-649; Roberts and Manchester 2010:255-256).

4.1.6 Dental Conditions

Teeth, due to their high mineral content, are sometimes the only surviving part of a skeleton in the archaeological record. As enamel does not remodel it is a constant record of events from a specific period of an individual's life (Buikstra 2019: 749; Buikstra and Ubelaker 1994:47; Roberts and Manchester 2010:63). Dental conditions include infectious pathologies (e.g., caries), degenerative pathologies (e.g., antemortem tooth loss and periodontal disease), developmental problems (e.g., enamel hypoplasia), and genetic abnormalities (Roberts and Manchester 2010:63).

All of the following dental conditions, except enamel hypoplasia, can cause antemortem tooth loss (AMTL) which therefore is not its own category. It is the premature loss of permanent teeth from trauma, chronic pathology, genetic factors, or intentional ablation. To identify if the loss of a tooth is antemortem the socket needs to be present and show signs of remodelling (Buikstra 2019:770; Roberts and Manchester 2010:74).

4.1.6.1 Enamel Hypoplasia

Enamel hypoplasia (EH) can take the form of lines, pits, or grooves on the enamel surface, and are the result of a defect in the enamel thickness as it is developing (Buikstra and Ubelaker 1994: 56; Roberts and Manchester 2010:75). Linear enamel hypoplasia (LEH) is the most common type, an example of LEH is seen in Figure 4.3 (Buikstra 2019:754). EH are non-specific indicators of stress and cannot be linked to one pathology in particular. There are however many factors to their development including systemic metabolic stress, hereditary predisposition, localized trauma, or environmental 'upsets' such as radiation and exposure to toxins. Systemic metabolic stress is the most common factor, and the cause can amongst other things be caused by dietary deficiencies and prolonged periods of sickness (Buikstra 2019:753-756;

Figure 4.3 *SZ12822's mandibula with linear enamel hypoplasia on the left first molar and ATML of the left canine. There is also a minor enamel defect on the second molar, but the defect is easier to feel than to observe. Photographed with a 5cm*5cm photo scale.*
Photo by Sara Georgine Fløien Schiøtz

Buikstra and Ubelaker 1994:56, 107; Roberts and Manchester 2010:75). It is not uncommon for the mean age at death of individuals with EH to be lower than the individuals without EH, as the systemic metabolic stress during childhood can weaken the immune system. The individual must, however, survive the initial stress that caused the EH for the enamel formation to return to normal as for the EH to be observable (Wood et al. 1992:354-355).

4.1.6.2 Caries and Abscesses

Caries is a multifactorial infectious pathology which is essentially the fermentation of food sugars of the bacteria that is in the plaque on the teeth causing the degeneration of the enamel which can eventually lead to the opening of a cavity and infection (Buikstra 2019:765; Roberts and Manchester 2010:65). They can affect all surfaces of the tooth and in Figure 4.4 there are two examples of cervical caries (originating at the cementoenamel junction (CEJ), top left and bottom right), two examples of large caries (having destroyed too much of the tooth to identify surface it originated on, top right and bottom middle), and one example of smoot surface caries (which originates on the buccal and/or lingual surface(s), bottom left) (Buikstra and Ubelaker 1994:55). Factors include trace elements in food and water, trauma, shape of the tooth, bacteria, diet, etc. Periodontal disease can also be the cause. Caries starts as small holes on the teeth, they can affect any surface of the tooth including the root. They may then increase in size and severity and can ultimately end with necrosis of the dentin and pulp cavity (Buikstra 2019: 765; Roberts and Manchester 2010:65).

Figure 4.4 *Five teeth from SZ20939 with cavities. The top right is the right M^1 and the bottom left is the left M_2, the three remaining have not been certainly identified as to which tooth they are, but they are all molars. Photographed with a 5cm*5cm photo scale.*
Photo by Sara Georgine Fløien Schiøtz

Abscesses are caused by the exposure of the pulp cavity and the subsequent infection. The exposure can be caused by caries, wear, and trauma (Buikstra and Ubelaker 1994:55; Roberts and Manchester 2010:66, 70). The infection will then spread down the root leading to inflammation of the alveolar bone, where dead cells and bacteria builds up leading to pressure. The pressure is either relieved through existing vascular canals in the bone or by formation of

a new sinus or hole in the bone. This sinus would be an abscess. There are also other alveolar lesions including periapical granuloma and apical cysts, both appearing as small, circumscribed lesions with a diameter under 3mm and over 3mm respectively (Buikstra 2019:767-768; Roberts and Manchester 2010:70).

4.1.6.3 Dental Calculus

Dental calculus is calcified plaque, which is the crystallization of a matrix made up of bacteria and micro-organism mixed with saliva proteins (Buikstra 2019:778; Roberts and Manchester 2010:71-72). It accumulates faster from diets that are higher in protein and/or carbohydrates. There are two types of calculus, the first is supra-gingival (above the gums) which is thick and grey or brown in colour. This is the most common type. The second type is subgingival (below the gums) which is harder, have a green or black colour, and commonly forms on exposed roots (Roberts and Manchester 2010:71-72).

4.1.6.4 Abnormal wear

Dental wear in and of itself is not a dental pathology, rather it is a natural process caused by the normal use of teeth for mastication. However, if the pulp cavity becomes exposed it is then viewed as a pathology if the pulp cavity (Buikstra 2019:764; Roberts and Manchester 2010:78). Extreme wear and loss of height may cause the tooth to 'continuously erupt' to compensate (Roberts and Manchester 2010:79). There are three types of dental wear: attrition, abrasion, and corrosive/erosive. Attrition is the wear caused by tooth-on-tooth contact commonly through mastication and/or bruxism (grinding of teeth). It causes matching wear on the teeth that are in occlusion. Abrasion is caused by extra-masticatory behaviour where the teeth are in contact with other objects, and sometimes food. Pipe smoking and the processing of animal hide with teeth are two common examples. Corrosive/erosive wear can affect any surface of the tooth and is the result of chemical dissolution of the tooth. Common causes include the regurgitation of stomach acid, consumption of acidic food, acidic polluted environment, and alcoholism (Buikstra 2019:764; Roberts and Manchester 2010:78).

4.1.6.5 Periodontal disease

Periodontal disease often starts out as gingivitis (inflammation of soft tissue) which then spreads to the bone causing alveolar resorption and rough porosity (Roberts and Manchester 2010:73). This inflammatory reaction is commonly caused by the build-up of plaque. The resorption causes the exposure of the root and increases the distance between the CEJ and the bone. It can also lead to the loss of periodontal ligaments, which hold the teeth in

place (Buikstra 2019: 771; Roberts and Manchester 2010:73-74). Roberts and Manchester (2010:73-74) suggest that periodontal disease might be over-diagnosed in archaeology, as attrition and continuous eruption can cause similar reaction to the alveolar bone.

4.1.7 Other

This category is for the lesions and pathologies that does not fit with any of the previous categories or cannot certainly be diagnosed.

One such pathology is Paget's disease, which while it is of unknown aetiology it has been linked with viral infections. Though it can also appear in kin groups and genetic mutations could also be a factor (More in Buikstra 2019:455). It is a chronic pathology which can affect one or several bones but never the entire skeleton. It causes excessive and localized remodelling of the bone at an increased rate, though the pathology in itself is slow and progressive. The bone becomes enlarged and often distorted, leading to deformities such as kyphosis of the spine and the bowing of long bones. The most commonly affected bones are the cranium, spinal column, sacrum, os coxae, femora, and tibiae (Buikstra 2019:455; Roberts and Manchester 2010:250-251). The enlargement of the cranium can cause the bone to encroach on the intercranial spine which can cause pressure and neurological conditions. This can also happen from pressure in other bones, like the spinal column (Buikstra 2019:457; Roberts and Manchester 2010:250-251).

4.2 Cofounding factors

The two collections do not use the same age groups, for Carter Lane they have four set age groups for adults and three groups for juveniles, as well as one general adult group for those that cannot be aged more accurately called 'unclassified adult'. While St. Nicholas Church does technically use age groups, two for juveniles and three for adults, they do also give the age range for each individual. The oldest age group for Carter Lane is >46+ years, while the oldest individuals from Nikolai are either the ones estimated to 60-80 years or the 65+ year old individual (Jensen 2018; Bekvalac et al. 2007). These differences can affect some of the comparisons, for example when it comes to pathologies with age as a factor, like osteoarthritis and osteoporosis.

4.2.1 Factors from the St. Nicholas Church Collection

The taphonomic processes have affected the bones and lead to fragmentation, loss of periosteal, cracking/crushing, and other effects that make the bones less than ideal when it comes to observing lesions. This is covered further in section 5.2.1 of this thesis.

Post-mortem trauma also posed as a problem as it can potentially 'hide' skeletal lesions in the area. Ten of the individuals have clear post-mortem trauma, and three more have possible post-mortem trauma. Some of the trauma might be animal gnawing, but most of it is either blunt or sharp force trauma. At least ten individuals have post-mortem trauma, and three additional might have. As graves have been cut by newer graves the origin of the trauma likely stems from this, as the trauma often is on the bones closest to where the grave has been cut. An example of this is SZ23815, which left tibia has a large notch on the proximal metaphysis. Of this individual only the tibiae and feet were recovered and neither tibia had the proximal epiphysis. The trauma on this individual was interpreted as being from a spade making contact with the bone as the new grave was dug, leading to the removal of the rest of the individual.

There have also been some problems with the collection itself. SZ29914 is missing its mandibular which is in photographs from the excavation. In Table 8 from Jensen (2018) the individual is marked under 'TANNFORHOLD' (*dental condition*) with 'other 1(3)' and the notes under the 'pathology/osteological changes' in the skeletal list (Table 9 Jensen:69) says 'severe dental wear and dental calculus'. As they were able to examine the individual's teeth it seems highly unlikely that preservation then led to the bone and teeth dissolving. No samples were taking from the individual, limiting the possibility of destruction from sample taking. All the boxes from C59892/43 to C59892/163 have been checked to see if the jaw could have been misplaced, but it has not been found. C59892/142 to C59892/163 are from charnel pit contexts. All the additional boxes for C59892/164 (which are loose finds) and the additional charnel pits (C60650) have not been checked as there are 32 C59892/164 boxes and 26 C60650 boxes for crania.

It was discovered that individuals other than those from Table 8 from Jensen (2018.) fit the criteria for this thesis and more individuals than the original 24 selected based on the table. This was discovered when examining the double grave SA50519 (C59892/44), from the table only the child, SZ18395, was included but the other individual, SZ50520, was discovered to also fit the criteria. The discovery of an individual fitting the criteria for the thesis led to the other *in situ* individuals also being checked to see if anymore fit, this search was combined

with the search of SZ29914's mandible. The search led to six more individuals, including SZ50520, being added to the thesis. The individual SZ15557 is in Table 8 from Jensen (2018), but under trauma. However, in Table 9 (2018) it is noted that the individual might have tuberculosis and no mention of the trauma. The individual SZ20939 is not in Table 8, but in Table 9 is noted as having caries, severe dental wear, and loss of teeth combined with remodelling of the jaw.

There are too many bones for SZ30577 marked as *in situ*, and at first it was believed that two different individuals were marked as SZ30577 by accident. This grave (SA30512) only contains one individual according to the report, the second individual's origin is thereby uncertain. The bones were sorted through and separated based on evidence of them having been affected differently by taphonomic processes, this led to the bones having different level of fragmentation and different colours. It also appears that two different people wrote on the bags for the two different individuals as there are clearly two distinct handwritings. The two individuals have been compared to the age, sex, pathologies, and photographs from the osteological report, and it is with confidence it has been identified which individual is SZ30577 from the report. The other individual was first thought to be SZ50577, this is a SZ-number from Table 8 from the original report (Jensen 2018:38-39) which does not occur anywhere else in the osteological report nor in the excavation report (Derrick 2018). The second individual fit the pathologies reported for SZ50577 in Table 8 (Jensen 2018), however when this individual was aged and sexed it became clear that the mandible and jaw was from an older individual than the rest of the cranium. This individual might therefore be *ex situ* and is not included in the study.

4.2.2 Factors from the London Blackfriars Collection

The original osteological report from this excavation is missing, meaning that a lot of insight and more detailed description of the individuals and lesions are not available.

There are some discrepancies with the number of individuals from the London Blackfriars collection. Watson (1990:52, 62) mentions the total of 58 articulated burials, made up of 48 adults and 10 children. Gavin (1990[1988]:6) mentions a total of 59 individuals, though when listing the individuals in the matrix only 51 individuals are mentioned (Gavin 1990[1987]:11-91). And in Gilchrist and Sloane (2005b) there are 60 individuals, they have 50 adults, two unaged individuals, and eight juveniles. Gilchrist and Sloane (2005b) do count one individual as 'young adult' that Bekvalac et al. (2007) count as a juvenile, their young adult

starts at 16 years while Bekvalac et al. (2007) start at 18 years. Bekvalac et al. (2007) only study 57 individuals, 48 adults and nine juveniles, which is the individuals used in this study.

The Museum of London is currently moving location, and due to this their Centre of Human Bioarchaeology and the collection is currently not available for research access. Doing the comparison of the two collections by comparing my data with the data published on their website (WORD 2022) is more than sufficient. However, ideally the data from both collections would have been collected by the same person as the difference in techniques can lead to differences in interpretations and results. More personal knowledge and understanding would have led to a more nuanced interpretation of the pathologies and conditions and would have made the comparison easier.

Taphonomic processes and preservation affected the individuals from the London Blackfriars. There have been multiple modern intrusions which have cut through graves and skeletons, these include the cellar mentioned in section 2.4 of this thesis as well as 19th century foundations, storm drains, cesspit, and various trenches (Gavin 1990[1987]:11-92). Of the 51 individuals mentioned in Gavin's matrix (1990[1987]:11-91) it is noted that roughly three-fourths of the individuals' grave cuts have been distributed in some way. Though it is only specified if also the skeletons where disturbed in one-third of the cases. Figure 1 from Bekvalac et al. (2007) show the completeness of the skeletons and just shy of one-third has less than 25% of the skeleton, and the highest completeness of the skeleton anyone has is 85-90%.

5 Methods

5.1 Collections

5.1.1 St. Nicholas Church's Collection

The collection includes the bones excavated by NIKU during 2014-2015 as part of the Follo Line project. The history of the church and previous excavations has been covered in section 2.3.3 of this thesis. From the 2014-2015 excavation NIKU recovered a total of 106 *in situ* individuals from 101 graves. With the additional 3909 loose bones recovered the MNI from the excavation is 430 (Jensen 2018:20). I will only be looking at the *in situ* individuals. Originally 24 individuals were selected based on Table 8 from Jensen (2018:38-39), which covers the pathologies from her analysis of the 2014-2015 NIKU excavation. Six further individuals have been added, why is explained in section 4.2.1 of this thesis. Both Tables 8 and 9 from Jensen (2018) have been recreated and can be found in Appendix B of this thesis.

The other excavations associated with the cemetery have a total MNI of 1,200, with the addition of the 2014-2015 excavation, the total MNI is 1,630 for a cemetery that was only in use for roughly 200 years. As stated in section 2.3.3 of this thesis there were five graves with bones and one empty grave at the limit of the excavation, meaning that the cemetery might be even larger.

When NIKU had finished their examinations and research on the human osteological remains they sent them to DSS, where the collection resides and where my osteological analysis was performed. The skeleton numbers (SZ-numbers) from NIKU's report will be used when referring to the individuals, as the C-numbers they are stored under at DSS refers to a context and not individuals. The C-numbers from DSS corresponds with the grave numbers (SA-numbers) from the NIKU report. Double graves are stored under the same C-number, and they also include any *ex situ* from the context. The C-number used for this collection is C59892 followed by a '/' and then a number which refers to the context. C59892/4-16 is from a different excavation, with the note on the boxes saying 'Grønlandsleiret 71-75(230/110)'. There are also three boxes for skulls from 'Hollender' under this C-number.

Table 5.1 *Individuals from St. Nicholas Church in the study*

DSS placement	Skeleton	Grave	Sex	Age
C59892/131	SZ12822	SA12821	Juvenile	6-8 years
C59892/129	SZ13199	SA13192	Male	50-70 years
C59892/130	SZ13206	SA13205	Female	22-33 years

C59892/110	SZ14571	SA14557	Female	50-60 years
C59892/111	SZ14604	SA14590	Male	30-40 years
C59892/122	SZ15244	SA15234	Female	50-70 years
C59892/114	SZ15261	SA15260	N/A	45-60 years
C59892/99	SZ15557	SA15547	Female	40-55 years
C59892/101	SZ15919	SA15918	Male	40-55 years
C59892/106	SZ17787	SA17786	Possible Male	28-40 years
C59892/68	SZ17909	SA17978	Female	50-65 years
C59892/44	SZ18395	SA50519	Juvenile	1-3 years
C59892/72	SZ18421	SZ18377	Male	35-45 years
C59892/74	SZ19170	SA19169	Male	55-70 years
C59892/77	SZ19834	SA19833	Female	60-80 years
C59892/80	SZ20283	SA20281	Possible Female	40-50 years
C59892/81	SZ20347	SA20345	Female	22-28 years
C59892/85	SZ20693	SA20681	Female	32-42 years
C59892/87	SZ20939	SA20930	Male	40-60 years
C59892/61	SZ23815	SA23806	N/A	30-50 years
C59892/62	SZ23869	SA23858	Female	30-45 years
C59892/140	SZ25196	SA25146	Male	65+ years
C59892/49	SZ29742	SA29740	Female	40-50 years
C59892/50	SZ29914	SA29913	Female	60-80 years
C59892/53	SZ30577	SA30512	Male	25-35 years
C59892/65	SZ50003	SA50002	N/A	25-32 years
C59892/43	SZ50507	SA50497	Female	28-35 years
C59892/44	SZ50520	SA50519	Female	22-28 years
C59892/45	SZ50522	SA50521	Female	28-35 years
C59892/45	SZ50524	SA50521	Juvenile	7-9 years

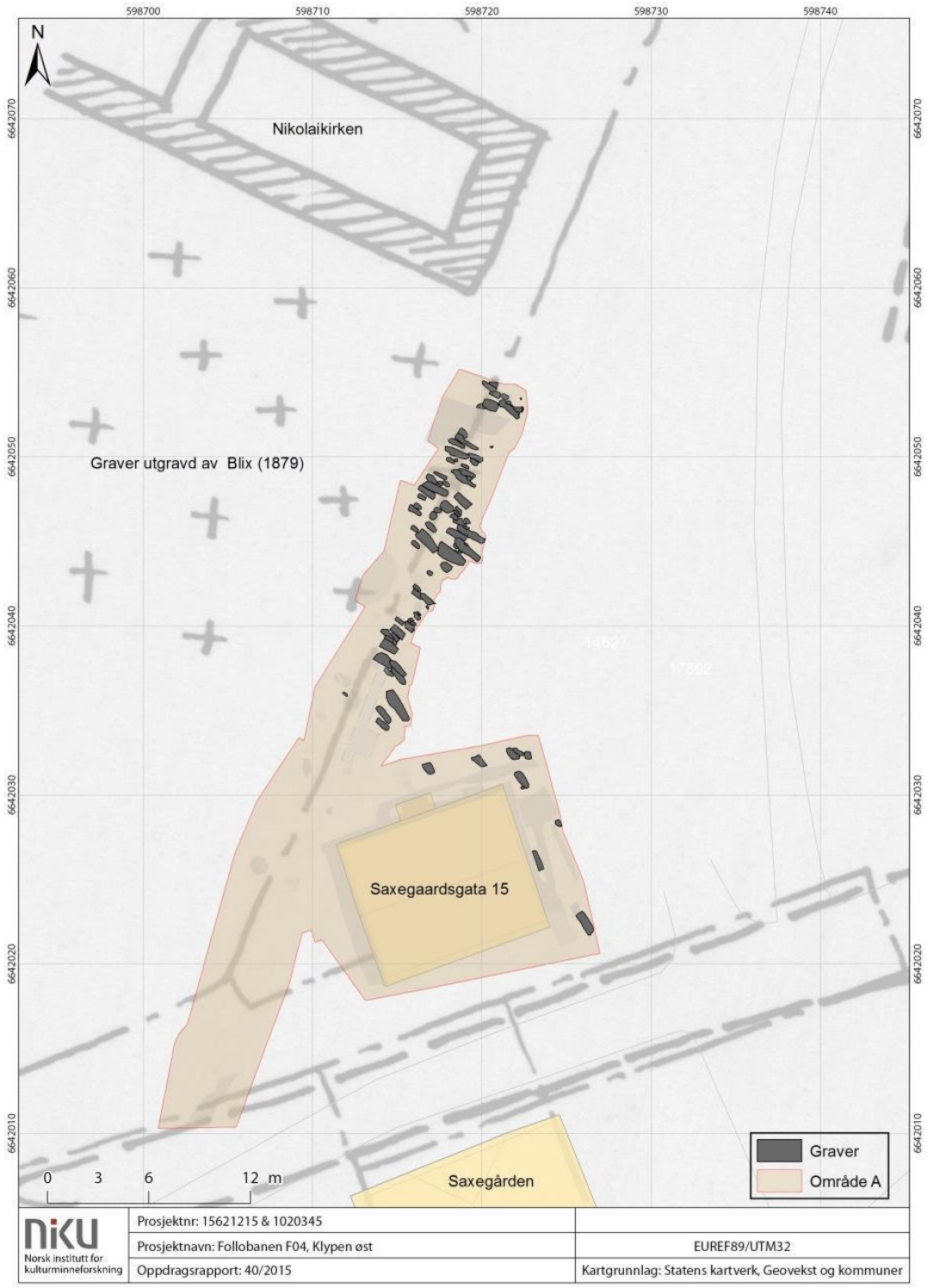

Figure 5.1 *Map of Cemetery associated with St. Nicholas Church. The graves marked with grey are the ones excavated between 2014 and 2015. Taken from Jensen (2018: Figure 1) with permission from NIKU*

NIKU has age and sex estimated the of the individual. They sex estimated the individuals by the *inscisura ischiaidca major*, *symphisis pubicus*, *glabella*, *protuberantia mentalis, processus mastoideus, protuberantia occipital extrena, caput humeri, caput femoris,* and length and width measurements of the humeri and femora. Of the *in situ* individuals 35.8% are children, 10.4% are male, 20.8% are women, and 33% are of undetermined sex, the

percentages are similar to those of all the individuals from the cemetery. For a more detailed description of the sex estimations see Chapter 5 from Jensen (2018:33-35).

They age estimated children based on development and eruption of the teeth, the length of the long bones, and the epiphyseal fusions. For adults they used tooth wear, cranial sutures, *symphysis pubicus, facies auricularis ossis ilii, fossa trochanteria, caput fovea, linea apsera,* and *eminentia intercondylaris.* As stated in section 2.3.1 the average age from the cemetery was 24.8 years when including both *in situ* and *ex situ* individuals, for adults the average age was 37.3 years with females' average age being 36.8 years and males' average age being 43.6 years. For a more detailed description of the age estimations see Chapter 6 from Jensen (2018:36-37).

5.1.2 The London Blackfriars Collection

The collection from the London Blackfriars, Carter Lane, London is from excavations that took place in 1987 and 1988. During these two periods of excavations 57 individuals were discovered. 15.8% of them are children, 28.1% are male, 21.1% are female, and the remaining 35.1% are of undetermined sex (Bekvalac et al. 2007). All the data used for this collection is available on the Wellcome Osteological Research Database website (WORD 2022) under 'Dominican Friary Carter Lane'. The data for how the individuals were given sex and age estimates can be found in the files 'Age estimates' and 'Sex estimates', while all the data used for the pathologies can be found in 'Dental pathology' and 'Pathology'. In their data they differentiate between intermediate and indeterminable sex, both will be referenced as N/A or 'individual of undetermined sex'. Of the 57 individuals 46 individuals fit the criteria for this thesis.

Table 5.2 *Individuals from the London Blackfriars in the study*

Skeleton	Sex	Age
32	Female	36-45 years
33	N/A	Unclassified adult
111	N/A	26-35 years
125	N/A	Unclassified adult
140	N/A	Unclassified adult
142	Male	26-35 years
159	N/A	>46 years
160	Juvenile	6-11 years

170	Possible female	18-25 years
175	Possible female	26-35 years
198	Juvenile	12-17 years
222	Male	>46 years
227	Possible female	Unclassified adult
228	Possible female	>46 years
234	Male	>46 years
237	Male	26-35 years
239	Possible male	18-25 years
240	Juvenile	12-17 years
241	N/A	36-45 years
242	Juvenile	1-5 years
243	Juvenile	12-17 years
256	N/A	Unclassified adult
257	Male	26-35 years
265	Possible male	36-45 years
274	N/A	Unclassified adult
305	Female	36-45 years
306	Male	18-25 years
318	Possible male	>46 years
320	Juvenile	12-17 years
325	Male	26-35 years
331	Male	36-45 years
334	Female	>46 years
343	Female	26-35 years
345	Female	>46 years
355	N/A	36-45 years
366	Female	36-45 years
376	Male	26-35 years
379	Male	18-25 years
382	N/A	18-25 years
405	N/A	26-35 years
415	Female	26-35 years

450	Male	26-35 years
462	N/A	Unclassified adult
504	Male	36-45 years
540	Possible male	Unclassified adult
648	Juvenile	6-11 years

There were few datable finds from the graves. *Terminus post quem* of the cemetery is based on stratigraphy as later than AD 1200 and *terminus ante quem* is based on the construction of a cellar in the eastern part of the cemetery from the second half of the 16th century. It is known that the Friary obtained it licence in AD 1275, though when it was constructed is not fully known but believed to have begun in 1279. The Friary was closed in 1538 and it is believed that the cemetery closed at the same time (Watson 1987:1; Watson 1990:47). The dates used by WORD (2022) from AD 1200 to 1538.

5.2 Osteological Techniques

There can be variations within the use of osteological terminology. When it comes to specific features on the bones I use the Latin nomenclature. When referring to individual teeth I use the same system as used on Buikstra and Ubelaker's (1994) attachments 16 through 18. This system refers to individual teeth with a letter used to indicate what type it is, and a lower case means deciduous while an upper case means permanent. The letters and the type of tooth are I/i for incisors, C/c for canines, P/p for premolars, and M/m for molars. As there are multiple incisors, premolars, and molars a number is used to indicate if it is a 1st or a 2nd, or a 3rd in the case of the molars. The numbers also indicate if the tooth is placed in the maxilla or the mandibula, teeth from the maxilla have the number written in superscript while teeth from the mandibula have the number written in subscript. For an example a permanent maxillary third molar is written M^3, while a deciduous mandibular second incisor is written i_2. The side which the tooth is from is referred to by left or right.

5.2.1 Source Criticism

There are obvious problems with studying osteological remains, like the osteological paradox (see section 3.2 of this thesis) and any post-mortem changes. Many of the individuals were heavily affected by taphonomic processes, leading to the bones being heavily fragmented and the periosteal part of the bone would fall of in flakes when touched. There were large differences to the preservation of the bones within a grave, and in some cases they could not

remove the individual without the bones dissolving or falling apart (Jensen 2018:30-31). For more on the preservation conditions see Chapter 4 of the original osteological report (Jensen 2018).

Even though I am following the standards by Buikstra and Ubelaker (1994), see section 5.2.2 of this thesis, there is still the possibility of human error. These standards were made to lessen the probability human error by creating a more universal vocabulary when describing, amongst other, lesions and pathologies during osteological observations. To further lessen the possibility of human error all individuals were checked twice at different dates to ensure accuracy.

5.2.2 Buikstra and Ubelaker's Standards

The standards for recording from Buikstra and Ubelaker's (1994) paper *Standards for data collection from human skeletal remains* was used when recording the observations from the osteological analysis of the skeletal remains from St. Nicholas Church. The forms used while preforming the analyses are from attachments from Buikstra and Ubelaker (1994) and were filled out using the scoring systems for teeth presented in Chapter 5 and the Skeletal Pathology Code Key from Chapter 6. The forms were filled out by hand while the individuals were documented and redone on computer to clean them up. The filled-out forms can be found on figshare.com (Schiøtz 2022a).

5.2.3 Reference Material

The reference material used include both pictures and written descriptions of lesions and pathological conditions. This material is mainly from Mays (2010), Roberts and Manchester (2010), Buikstra (2019), Buikstra and Ubelaker (1994), and Unit of Anthropology, Department of Forensic Medicine, University of Southern Denmark [ADBOU] (2015) and include both text, photographs, and illustrations. Pictures on Instagram by Emma Bonthorne (@the_wandering_archaeologist) was also used, as her pictures were sharper than most from the other reference material.

5.2.4 Methods Used

The only tools used were callipers and a 3x magnifying glass. The callipers were used to estimate size or placement of lesions when relevant. The magnifying glass was used to look closer at lesion to properly identify all characteristics of said lesion, or to identify whether there was a lesion or not in areas that were highly affected by the taphonomic processes or was rather fragmented.

The reference material was studied before doing the observations of the individuals to familiarize myself with how to best identify different types of lesions and pathologies. Pictures from the different books and from Bonthorne's Instagram account was compiled into a document with some short descriptions where needed, this document was printed and brought with me when observing the individuals to serve as references. All the relevant pathologies from ADBOU (2015) were also printed and brought with me to use during the documentation process. A third document with reference pictures of common non-metric features was also printed and brought as reference. These documents were consulted when needed to ensure accuracy. Any lesions observed that did not correspond with any of the documents nor codes from Buikstra and Ubelaker (1994) was described as accurately as possible and was checked against the written descriptions when possible.

The sex and age from the original report were used, the techniques used has been mentioned in their respective sections (5.1.1 and 5.1.2).

6 Results

The results from the two collections are given in separate sections which are further separated based on a category of pathologies or conditions. Each category starts with a table that shows the pathologies and/or conditions within the category, who and how many had each pathology and/or condition, and the percentage of the total *in situ* individuals from the collection that is. Following the table is a paragraph giving further detail.

6.1 St. Nicholas Church

Of the 106 *in situ* individuals 30 of them were determined to have evidence for a pathology or condition relevant to this thesis. Which makes up 28.3% of the *in situ* individuals from the collection. The individuals do on average have 2.3 pathologies and/or conditions with a standard deviation of 1.4 and a median of 2. However, it is possible that even more had relevant pathologies or conditions but has been lost due to the preservation and taphonomic processes. Taphonomic processes and preservation could lead to the destruction of relevant material, see sections 4.2.1 and 5.2.1 of this thesis. There is also known post-mortem trauma to one-third of the individuals in this study, see section 4.2.1 of this thesis.

In this section the tables are specific for each pathology or condition category. A table which contains all these tables combined, and with additional data, is available on figshare.com (Schiøtz 2022b). All the data used for graphs, medians, means, and standard deviations are also available at place.

6.1.1 Infectious

Table 6.1 *Individuals with infectious pathologies from St. Nicholas Church, specifying what pathologies the various individuals had. Under 'No. of pathologies' is given the number of pathologies from this category each individual had. The totals are the total of individuals had each pathology, while the percentages is the percentage this makes up of the total in situ collection. The 'Total' and 'Percentage' rows under the 'No. of pathologies' column show the total number of individuals within the category and what percentages they make up of all in situ individuals.*
The individual whose sex is 'M?' is 'possible male.'

Individual	Sex	Age Range	Tuberculosis	Possible TB	Lepra	Possible Lepra	No. of pathologies
SZ13206	F	22-30	X				1
SZ20347	F	22-28	X				1
SZ14604	M	30-40		X			1
SZ17787	M?	28-40				X	1
SZ50522	F	28-35			X		1
SZ20693	F	32-42	X				1
SZ15557	F	40-55		X			1
SZ29742	F	40-50			X		1

SZ19170	M	55-70			X		1
Total			3	2	3	1	9
Percentage			2.8%	1.9%	2.8%	0.9%	8.5%

All individuals with infectious pathologies only have one. One-third of the infectious pathologies are uncertain, all these cases would likely be in the early stages if they had said pathology. In the case of SZ14604 the individual also has OA which could potential 'hide' some skeletal involvement related to TB. SZ29742 have early signs of RMS, and of the individuals with lepra is the only one with lepromatous lepra. SZ20347 only has evidence of TB on the os coxae and the sacrum. From this individual all the lumbar vertebrae and the lower eight thoracic vertebrae are preserved, and none of them show any signs of TB or any other pathology. As there are only evidence of TB on the os coxae and the sacrum this individual is diagnosed with sacral TB. SZ20347's sacrum is shown in Figure 4.1.

6.1.2 Joints

Table 6.2 *Individuals with joint pathologies from St. Nicholas Church, specifying what pathologies the various individuals had. Under 'No. of pathologies' is given the number of pathologies from this category each individual had. The totals are the total of individuals had each pathology, while the percentages is the percentage this makes up of the total in situ collection. The 'Total' and 'Percentage' rows under the 'No. of pathologies' column show the total number of individuals within the category and what percentages they make up of all in situ individuals.*
The individual whose sex is 'F?' is 'possible female.

Individual	Sex	Age Range	Osteoarthritis	Possible osteoarthritis	No. of pathologies
SZ14604	M	30-40	X		1
SZ23815	N/A	30-50	X		1
SZ23869	F	30-45		X	1
SZ29742	F	40-50	X		1
SZ19170	M	55-70	X		1
SZ20283	F?	40-50	X		1
SZ15919	M	40-50	X		1
SZ25196	M	65+	X		1
SZ14571	F	50-65	X		1
SZ17909	F	50-65	X		1
SZ13199	M	50-70	X		1
SZ15261	N/A	45-60	X		1
SZ19834	F	60-80	X		1
Total			12	1	13
Percentage			11.3%	0.9%	12.3%

As there is only one joint pathology identified from the collection none of the individuals can have more, or less, than one pathology. The probable individual had only the acetabulum of the 'major joints' present but had osteophytic formation on vertebrae and both os coxae.

6.1.3 Congenital

Table 6.3 *Individuals with congenital conditions from St. Nicholas Church, specifying what conditions the various individuals had. Under 'No. of conditions' is given the number of conditions from this category each individual had. The totals are the total of individuals had each condition, while the percentages is the percentage this makes up of the total in situ collection. The 'Total' and 'Percentage' rows under the 'No. of conditions' column show the total number of individuals within the category and what percentages they make up of all in situ individuals.*
The individual whose sex is 'M?' is 'possible male'.

Individual	Sex	Age Range	Congenital other	Spondylolysis	No. of conditions
SZ17787	M?	28-40	X		1
SZ50507	F	28-35	X		1
SZ15244	F	50-70	X		1
SZ25196	M	65+		X	1
Total			3	1	4
Percentage			2.8%	0.9%	3.8%

All the individuals only have one congenital condition. SZ50507 is missing the right *facies articularis inferior* on L5 causing the right *facies articularis inferior* of L4 to elongate to compensate, as shown in Figure 6.1. The right *facies articularis superior* is present on the L5. The two other individuals under 'Congenital other' have fusion of the distal interphalangeal joint of the 5th toe. SZ15244 has this on both feet, and some minor additional bone formation to other petal phalanges. SZ17787 has it on the right foot, though the relevant bones from the left foot is missing. SZ25196 has spondylolysis of L4 and L5 with signs of remodelling showing that it was not recent, as shown in Figure 4.2.

Figure 6.1 *SZ50507's L4 and L5 viewed from the posterior aspect, not the missing facies articularis inferior on the L5 and how the L4 have compensated for it. Photographed with a 5cm*5cm photo scale.*
Photo: Sara Georaine Fløien Schiøtz

6.1.4 Neoplastic

Table 6.4 *Individual with neoplastic pathology from St. Nicholas Church, specifying what type of neoplastic pathology the individual had. Under 'No. of pathologies' is given the number of pathologies from this category the individual had. The percentage is what percentages this makes up the total in situ collection. The 'Percentage' row under the 'No. of pathologies' column show the percentages of all in situ individuals in the category.*

Individual	Sex	Age Range	Button Osteoma	No. of pathologies
SZ14571	F	50-65	X	1

Percentage			0.9%	0.9%

There is only one individual with a neoplastic pathology, this is a button osteoma on the right side of the occipital.

6.1.5 Dental Conditions

Only 30 of the 106 *in situ* individuals have teeth according to the catalogue from Jensen (2018:83-184) making up 28.3%, and three more had the mention of one or three teeth found in the grave. 14 of the individuals with any pathologies have any teeth present. Though SZ29914 is included in Jensen's Table 8 (2018) its jaw is missing, the data from the table is used, making it a total of 15 individuals with dental conditions. This makes up 50% of all individuals with pathologies. None of the individuals with teeth and pathologies had all their teeth, and five individuals had less than half of their teeth. Of these, one individual only had two teeth.

Table 6.5 *Individuals with dental conditions from St. Nicholas Church, specifying what conditions the various individuals had. Under 'No. of conditions' is given the number of conditions from this category each individual had. The totals are the total of individuals had each condition, while the percentages is the percentage this makes up of the total in situ collection. The 'Total' and 'Percentage' rows under the 'No. of conditions' column show the total number of individuals within the category and what percentages they make up of all in situ individuals.*
**SZ29914 is missing its mandible so the data is gathered from Jensen 2018 Table 8*

Individual	Sex	Age Range	EH	Caries	Alveolar lesion	Wear	Calculus	No. of conditions
SZ18395	Child	1-3	X					1
SZ12822	Child	6-8	X					1
SZ50524	Child	7-9	X				X	2
SZ50520	F	22-28				X		1
SZ30577	M	25-35		X			X	2
SZ14604	M	30-40				X	X	2
SZ50522	F	28-35			X		X	2
SZ50003	N/A	25-32		X			X	2
SZ18421	M	35-45		X	X			2
SZ20939	M	40-60		X	X	X		3
SZ29742	F	40-50		X	X	X	X	4
SZ19170	M	55-70				X	X	2
SZ29914*	F	60-80				X	X	2
SZ14571	F	50-65		X	X		X	3
SZ19834	F	60-80					X	1
Total			3	6	5	6	10	15
Percentage			2.8%	5.7%	4.7%	5.7%	9.4%	14.2%

This is the largest category by roughly 3%, and it also the category where the most individuals have multiple conditions. As seen from Figure 6.2 the majority had two conditions, which also is the average. The standard deviation is 0.8, and with a median of 2.2 it is the only category where the median is higher than 1. All cases of calculus are supragingival.

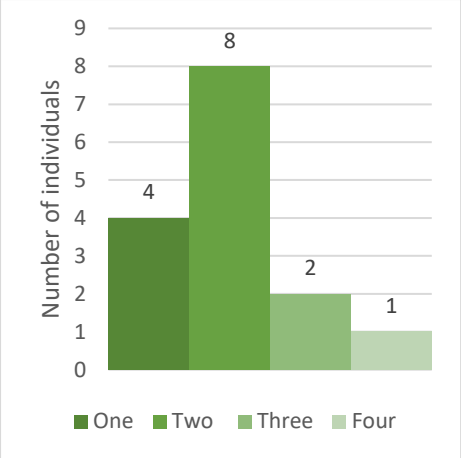

Figure 6.2 *Number of individuals with one or more dental condition from St. Nicholas Church*

In addition to the conditions presented in Table 6.5 there are two possible cases (1.9%) of periodontal disease. These are SZ14604, whose maxillary alveolar bone appears to be slightly drawn from the teeth, and SZ19170, whose mandibular alveolar bone appears slightly drawn with a rough feel to the bone from the lingual aspect of the molars. These two individuals are not added in Figure 6.2 but if they were there would be six individuals with two conditions and four individuals with three conditions. And it would shift the average to 2.1 and the standard deviation to 0.9 while the median would stay the same.

All the cases of EH are juvenile, affecting 100% of the juveniles with any pathology, and the two youngest only have EH while the oldest also have dental calculus. All cases are LEH. None of the juveniles have any other pathology nor condition. The individuals with EH do on average have 5.7 affected teeth with a standard deviation of 0.6, and a median of 6.

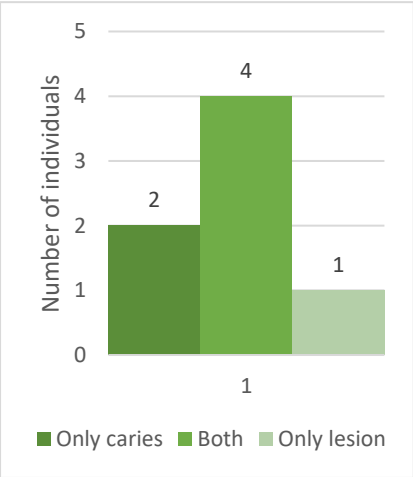

Figure 6.3 *Number of individuals with caries, alveolar lesions, or both from St. Nicholas Church*

Caries and alveolar lesions commonly occur together, and all of the alveolar lesions from St. Nicholas Church has been identified as abscesses. Of all the individuals with teeth 23.3% have either one or both of them. The majority had both, see Figure 6.3. The individuals with caries do on average have two cavities with a standard deviation of 2 and a median of 1. While the individuals with alveolar lesions on average have 2.8 lesions with a standard deviation of 1.3 and a median of 3.

6.1.6 Other

Table 6.6 *Individuals with joint pathologies from St. Nicholas Church, specifying what pathologies the various individuals had. Under 'No. of pathologies' is given the number of pathologies from this category each individual had. The totals are the total of individuals had each pathology, while the percentages is the percentage this makes up of the total in situ collection. The 'Total' and 'Percentage' rows under the 'No. of pathologies' column show the total number of individuals within the category and what percentages they make up of all in situ individuals.*
The individuals whose sex are 'M?' and 'F?' are 'possible male' and 'possible female' respectively.
Dep. Pub. S.=Depression on the pubis symphysis, Comp. frac. =Compression fracture

Individual	Sex	Age Range	Bone formation	Bone loss	Dep. Pub. S.	Comp. frac.	Other	No. of pathologies
SZ20347	F	22-28					X	1

SZ17787	M?	28-40	X	X				2
SZ18421	M	35-45		X				1
SZ23869	F	30-45	X	X	X			3
SZ20283	F?	40-50				X		1
SZ15244	F	50-70	X					1
SZ17909	F	50-65	X					1
SZ19834	F	60-80	X	X		X		3
Total			5	4	1	2	1	8
Percentage			4.7%	3.8%	0.9%	1.9%	0.9%	7.5%

The most common pathology is abnormal bone formation followed by abnormal bone loss. 5.7% have either or both of them. On average the individuals of this category have 1.6 pathologies with a standard deviation of 0.9, and the median is one. Twice as many have three other pathologies as have two, Figure 6.4.

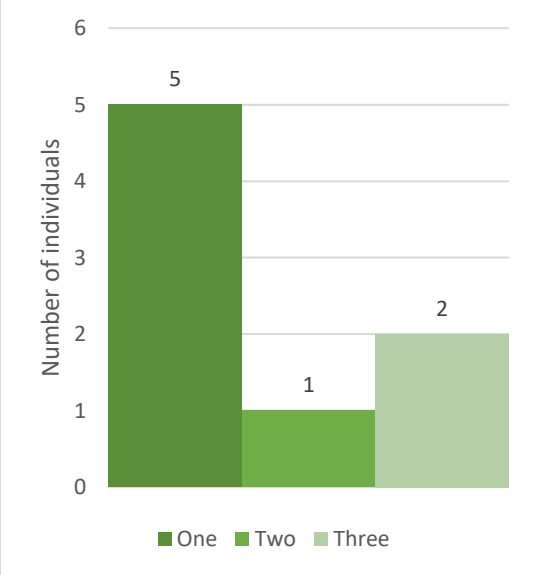

Figure 6.4 *Number of individuals with one or more 'other' pathology from St. Nicholas Church*

Three individuals have both abnormal bone formation and loss. This is SZ17787 whom possible has lepra and both the loss and the formation could be indicators of the early stages of lepra. In addition, there is bone loss on the proximal articulating surface on one of the 2nd phalanx of right hand, creating a deep pit. SZ23869 is also affected by both and has bone loss to both os coxae, affecting the auricular surface, ischium, and acetabulum. The changes do not appear to be age related. All the sites of loss also have some osteophytic formation, with a possible relation between the two. This individual also has a depression on the pubis symphysis associated with multiple births.

SZ18421 has some minor bone loss to the posterior aspect of the clavicles, the only other lesion this individual has is caries. SZ15244 has some minor additional bone on multiple petal phalanges, this is individual also has fusion of the distal interphalangeal joints of the fifth toes. SZ17909 has bone formation on both humeri, it presents as lipping made up by a combination of woven bone and sclerotic reaction along the distal one-third of the *crista supraepicondylaris medialis*. This individual also has OA mainly affecting the spine.

The last individual with bone formation and loss is SZ19834, whom also has compression fracture and OA. The left big toe's distal end of the 1st phalanx and the left auricular surface both are affected by loss. The most extreme changes are the bone formation

to the left hand's 2nd and 3rd digits, especially affecting the bone closest to the metacarpophalangeal joints. All four affected bones have expansion of the bone, and on the medial aspect of the 3rd digit's proximal phalanx is what appears to be an involucrum and perforation of the cortex due to a cloaca. This could indicate a that it is the result of an infection, but the cause cannot be certain. As seen on Figure 6.5 the 3rd digit has greater bone formation than the 2nd digit. The 3rd digit's proximal phalanx seen from the medial or lateral view is wider at the proximal end than normal due to bone formation. The joints have eburnation to the degree of reflecting light and the bone is mature, the lesions are in other words inactive.

Figure 6.5 *SZ19834's 3rd digit's metacarpal and proximal phalanx (left) and 2nd digit's metacarpal and proximal phalanx (right). On both digits it the bone closest to the metacarpophalangeal joint which is the most affected, and the 3rd digit has greater bone formation than the 2nd. Photographed with a 5cm*5cm photo scale. Photo by Sara Georgine Fløien Schiøtz*

The one individual marked with 'Other' have some abnormally shaped thoracic vertebrae, T5-T7 for certain and possibly T4 and T8. The spines all point slightly towards the right and the centra of T5-T7, and possibly T8, all protrude on the right side. The compression fractures affect SZ20283's T7 and possibly L5, but it is too fragmented to be certain, and SZ19834's T12, this individual's T3 has a similar but milder lesion which could indicate a second fracture.

6.2 London Blackfriars

The collection has 57 *in situ* individuals and 46 of these had some pathology or condition relevant to this study, making up 80.7% of the *in situ* individuals. However, taphonomic processes and preservation could have led to the loss of relevant skeletal material, and as mentioned in section 4.2.2 many of the graves were disturbed by later intrusions. Even though 80.7% of the *in situ* individuals is a large percentage it is possible that even more individuals had any pathology or condition, but that the affected bones are lost. The individuals do on average have 3.7 pathologies and/or conditions with a standard deviation of 2.2 and a median of 3.

6.2.1 Infectious

Table 6.7 *Individuals with infectious pathologies from the London Blackfriars, specifying what pathologies the various individuals had. Under 'No. of pathologies' is given the number of pathologies from this category each individual had. The totals are the total of individuals had each pathology, while the percentages is the percentage this makes up of the total in situ collection. The 'Total' and 'Percentage' rows under the 'No. of pathologies' column show the total number of individuals within the category and what percentages they make up of all in situ individuals.*
The individuals whose sex are 'M?' and 'F?' are 'possible male' and 'possible female' respectively.

Individual	Sex	Age Range	Non-specific periostitis	No. of pathologies
170	F?	18-25	X	1
175	F?	26-35	X	1
325	M	26-35	X	1
32	F	36-45	X	1
241	N/A	36-45	X	1
366	F	36-45	X	1
222	M	>46	X	1
234	M	>46	X	1
318	M?	>46	X	1
256	N/A	Adult	X	1
274	N/A	Adult	X	1
Total			11	11
Percentage			19.3%	19.3%

There is only one infectious pathology found in the collection, non-specific periostitis. While it affects nearly one-fifth of the collection based on the descriptions of the affected bones (WORD 2022) it appears that most cases are relatively mild.

6.2.2 Joints

Table 6.8 *Individuals with joint pathologies from the London Blackfriars, specifying what pathologies the various individuals had. Under 'No. of pathologies' is given the number of pathologies from this category each individual had. The totals are the total of individuals had each pathology, while the percentages is the percentage this makes up of the total in situ collection. The 'Total' and 'Percentage' rows under the 'No. of pathologies' column show the total number of individuals within the category and what percentages they make up of all in situ individuals.*
The individual whose sex is 'F?' is 'possible female'.

Individual	Sex	Age Range	Osteoarthritis	DISH	Ankylosis	Joint other	No. of pathologies
111	N/A	26-35	X			X	2
237	M	26-35				X	1
331	M	36-45	X				1
222	M	>46	X	X	X		3
234	M	>46		X		X	2
334	F	>46	X				1
345	F	>46				X	1
125	N/A	Adult				X	1
140	N/A	Adult	X				1
227	F?	Adult	X				1
256	N/A	Adult				X	1
Total			6	2	1	6	11

Percentage			10.5%	3.5%	1.8%	10.5%	19.3%

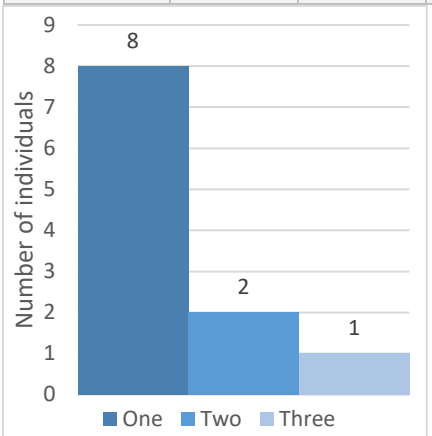

Figure 6.6 *Number of individuals with one or more joint pathology from the London Blackfriars*

The majority of the individuals with joint pathologies only have one, but there are some with two and three pathologies as well, see Figure 6.6. The individuals have an average of 1.4 pathologies with standard deviation of 0.7, and a median of one.

The 'Joint other' category is mainly made up of unspecific (osteophytic) lipping. 125 and 237 are also noted to have degenerative joint disease (DJD) and it is written '?DJD' on 256, interpreted to mean possible DJD. The separation of OA and 'Joint other' of 111 is eburnation in the former and osteophytic lipping in the later, though the eburnation is also mentioned.

6.2.3 Circulatory and Metabolic

Table 6.9 *Individuals with circulatory and metabolic pathologies from the London Blackfriars, specifying what pathologies the various individuals had. Under 'No. of pathologies' is given the number of pathologies from this category each individual had. The totals are the total of individuals had each pathology, while the percentages is the percentage this makes up of the total in situ collection. The 'Total' and 'Percentage' rows under the 'No. of pathologies' column show the total number of individuals within the category and what percentages they make up of all in situ individuals.*
The individuals whose sex are 'F?' are 'possible female'.
Osteoc. Dis. = Osteochondritis Dissecans

Individual	Sex	Age Range	CO Left	CO Right	CO Both	Osteo-porosis	Freiberg's disease	Osteoc. Dis.	Blood other	No. of pathologies
242	Child	1-5			X					1
240	Child	12-17	X						X	2
243	Child	12-17	X							1
320	Child	12-17			X					1
170	F?	18-25						X		1
306	M	18-25	X							1
382	N/A	18-25	X							1
450	M	26-35		X						1
241	N/A	36-45					X			1
222	M	>46		X						1
228	F?	>46			X					1
334	F	>46	X			X				2
227	F?	Adult						X		1
274	N/A	Adult						X		1
Total			5	2	3	1	1	3	1	14
Percentage	14		4.7%	1.9%	2.8%	1.8%	1.8%	5.3%	1.8%	24.6%

The circulatory and metabolic pathologies category is the second largest of the categories and affects almost one-fourth of the individuals. The majority have only one

pathology, with only two having two pathologies. The individuals do on average have 1.1 pathology with a standard deviation of 0.4, and the median is one.

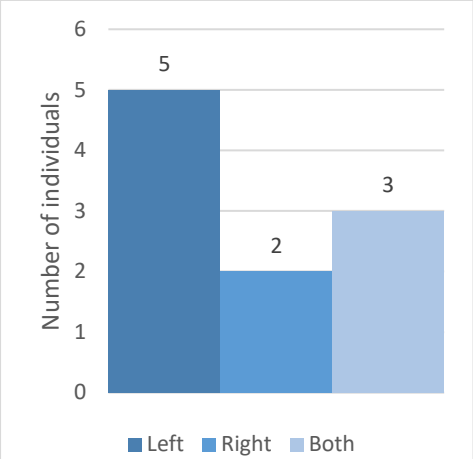

Figure 6.7 *Individuals affected by Cribra orbitalia in right, left, or both orbits from the London Blackfriars*

The 'Blood other' is one case of a '*bilateral spicular bone growth*' (WORD 2022) on the *collum femoris*, side not specified though further description of the placement is. The individual with osteoporosis has a possible Colle's fracture.

The most common pathology is CO, occurring in 17.5% of the individuals. It most commonly occurs in the left orbit, which as shown on Figure 6.7 makes up half of all cases of CO. CO affect individuals of all ages. There are no references to whether or not the lesions were active or not that the individuals age at death.

6.2.4 Congenital

Table 6.10 *Individuals with congenital conditions from the London Blackfriars, specifying what conditions the various individuals had. Under 'No. of conditions' is given the number of conditions from this category each individual had. The totals are the total of individuals had each condition, while the percentages is the percentage this makes up of the total in situ collection. The 'Total' and 'Percentage' rows under the 'No. of conditions' column show the total number of individuals within the category and what percentages they make up of all in situ individuals.*
The individual whose sex is 'F?' is 'possible female'.
Cong. other = Congenital other, Extrano. vertebrae=extranumary vertebrae

Individual	Sex	Age Range	Cong. other	Extrano. vertebrae	CDH	Bathro-cephaly	No. of conditions
170	F?	18-25	X				1
306	M	18-25		X	X		2
379	M	18-25		X		X	2
504	M	36-45			X		1
222	M	>46	X				1
462	N/A	Adult	X				1
Total			3	2	2	1	6
Percentage			5.3%	3.5%	3.5%	1.8%	10.5%

This is one of the smaller categories from the collection. Two-thirds have only one condition while the remaining one-third have two, on average the individuals have 1.3 conditions with a standard deviation of 0.5 and a median of one.

In the original data the only condition with its own category was bathrocephaly, extranumary vertebrae and congenital dislocation of the hip (CDH) were under 'Congenital other'. These have been given their own columns as to fully see which individuals were affected by more than one condition. The remaining conditions in 'Congenital other' are 222 which

might have spina bifidia occulta (SBO) but the sacrum it too fragmented to be certain, 170 which has one fused distal interphalangeal joint on the right foot, and 462 which has a *calcaneus secundarius* and a necrotic appearing area on their calcaneus which might be associated with the deltoid ligament or the *extensor digitorum brevis*, side not specified.

6.2.5 Neoplastic

Table 6.11 *Individual with neoplastic pathology from the London Blackfriars, specifying what type of neoplastic pathology the individual had. Under 'No. of pathologies' is given the number of pathologies from this category the individual had. The percentage is what percentages this makes up the total in situ collection. The 'Percentage' row under the 'No. of pathologies' column show the percentages of all in situ individuals in the category.*

Individual	Sex	Age Range	Osteoma	No. of pathologies
450	M	26-35	X	1
Percentage			1.8%	1.8%

This is the smallest category with only one individual, the individual has an osteoma on the right tibia with some periostitis associated with it.

6.2.6 Dental Conditions

Only 39 of the *in situ* individuals have teeth, making up 68.4% of all *in situ* individuals (Bekvalac et al. 2007). All of the juveniles have teeth. There are 32 individuals with any dental conditions, making up 82.1% of all individuals with teeth. While it is not specified on WORD's website (2022) the majority of the individuals with teeth are probably missing at least some teeth.

Table 6.12 *Individuals with dental conditions from the London Blackfriars, specifying what conditions the various individuals had. Under 'No. of conditions' is given the number of conditions from this category each individual had. The totals are the total of individuals had each condition, while the percentages is the percentage this makes up of the total in situ collection. The 'Total' and 'Percentage' rows under the 'No. of conditions' column show the total number of individuals within the category and what percentages they make up of all in situ individuals.*
The individuals whose sex are 'M?' and 'F?' are 'possible male' and 'possible female' respectively.

Individual	Sex	Age Range	EH	Caries	Alveolar lesion	Wear	Periodontal disease	Calculus	No. of conditions
160	Child	6-11		X	X			X	3
648	Child	6-11		X				X	2
198	Child	12-17	X					X	2
240	Child	12-17	X					X	2
243	Child	12-17	X					X	2
320	Child	12-17						X	1
170	F?	18-25	X	X				X	3
239	M?	18-25	X					X	2
306	M	18-25	X	X				X	3
379	M	18-25		X	X			X	3
382	N/A	18-25	X				X	X	3
111	N/A	26-35			X		X	X	3

142	M	26-35	X					X	2
175	F?	26-35		X	X			X	3
237	M	26-35						X	1
257	M	26-35	X				X	X	3
325	M	26-35					X	X	2
343	F	26-35	X	X			X	X	4
376	M	26-35	X	X			X	X	4
405	N/A	26-35	X					X	2
415	F	26-35						X	1
450	M	26-35	X		X		X	X	4
241	N/A	36-45		X	X		X	X	4
265	M?	36-45					X	X	2
305	F	36-45	X	X	X			X	4
331	M	36-45	X	X			X	X	4
355	N/A	36-45		X				X	2
504	M	36-45		X	X		X	X	4
159	N/A	>46					X	X	2
222	M	>46	X	X	X		X	X	5
228	F?	>46		X				X	2
234	M	>46		X	X	X		X	4
334	F	>46					X	X	2
345	F	>46	X					X	2
33	N/A	Adult						X	1
227	F?	Adult			X	X	X	X	4
Total			17	16	11	2	15	36	36
Percentage			29.8%	28.1%	19.3%	3.5%	26.3%	63.2%	63.2%

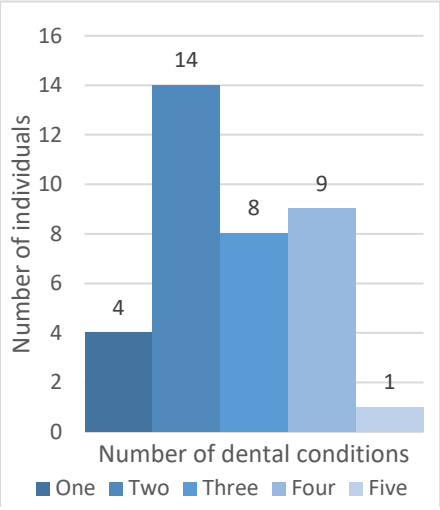

Figure 6.8 *Number of individuals with one or multiple dental conditions from the London Blackfriars*

This is the largest category of the collection and is also the one where most individuals have multiple conditions. As shown on Figure 6.8 the majority have more than one condition, with 86.1% having two, three, or four conditions. The individuals have 2.7 conditions on average with a standard deviation of 1.1, and with a median of 2.5 this is the only category to have a median higher than one.

Dental calculus affects 100% of all adults and 66.7% of all juveniles with teeth, in total it affects 92.3% of all individuals with teeth and the only ones without it are the ones in the 1-5 year age group. EH is quite common affecting close to half of the individuals with teeth, affecting 43.6%. The individuals with EH do on average have 4 affected

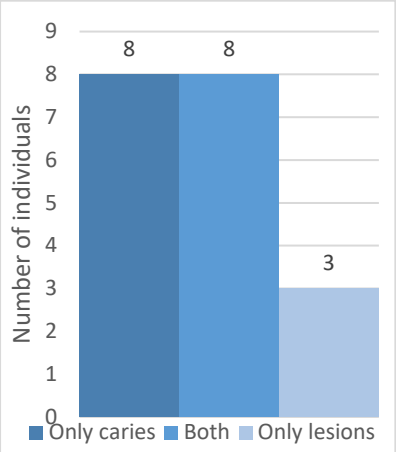

Figure 6.9 *Number of individuals with either caries, alveolar lesions, or both from the London Blackfriars*

teeth with a standard deviation of 4.1 and a median of 2.

48.7% of all individuals with teeth have caries, alveolar lesions (called periapical lesions in WORD 2022), or both. As shown on Figure 6.9 of the individuals with caries half of them also have alveolar lesions. The individuals with caries do on average have three cavities with a standard deviation of 2.5 and a median of 2. While the individuals with alveolar lesions on average have 1.6 lesions with a standard deviation of 1.0 and a median of 1.

6.2.7 Other

Table 6.13 *Individuals with other pathologies from the London Blackfriars, specifying what pathologies the various individuals had. Under 'No. of pathologies' is given the number of pathologies from this category each individual had. The totals are the total of individuals had each pathology, while the percentages is the percentage this makes up of the total in situ collection. The 'Total' and 'Percentage' rows under the 'No. of pathologies' column show the total number of individuals within the category and what percentages they make up of all in situ individuals.*
The individuals whose sex are 'M?' and 'F?' are 'possible male' and 'possible female' respectively.
Gen. other= General other, Osteop.=Osteophytes, Bone form.= Bone formation, Comp. fract.= Compression fracture, No. of path.= Number of pathologies

Individual	Sex	Age Range	Gen. other	Osteop. /lipping	Bone form.	Entheso-pathy	Strong Muscle	Comp. fract.	Paget's disease	No. of path.
170	F?	18-25					X			1
382	N/A	18-25	X				X			2
237	M	26-35			X	X				2
343	F	26-35						X		1
241	N/A	36-45				X				1
366	F	36-45	X							1
159	N/A	>46		X						1
228	F?	>46	X	X						2
234	M	>46	X							1
318	M?	>46		X		X				2
334	F	>46	X		X					2
227	F?	Adult	X	X						2
540	M?	Adult							X	1
Total			6	4	2	3	2	1	1	13
Percentage			10.5%	7.0%	3.5%	5.3%	3.5%	1.8%	1.8%	22.8%

The other category makes up between one-fourth and one-fifth of the collection. It is almost evenly split between the ones with one and two pathologies, as shown on Figure 6.10. The individuals have 1.5 pathologies on average with a standard deviation of 0.5.

Compression fracture and Paget's disease had their own categories while the remaining were all part of 'General Pathology Comments'. This has been separated as to see if any individuals were affected by multiple pathologies and to see if there were any of the 'other pathologies' that occurred more frequently than others. Neither 343 nor 540 had any 'General Pathology Comments', so before separating out some of the pathologies it appeared that all individuals only had one pathology. Over half of the individuals under 'General Pathology Comments' had two pathologies. And overall, 46.2% of the 'Other' category have two pathologies, the remain 53.8% only have one.

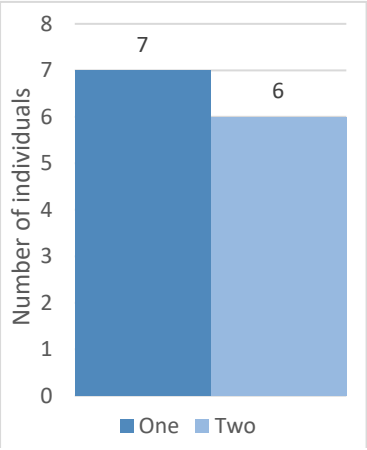

Figure 6.10 *Number of individuals with either one or two pathologies from the 'other' pathology category from the London Blackfriars*

The individuals in 'General other' all have pathologies that would be easy to put in a specific category or which would be the only case of said pathology. 228 has probable sacralisation of L5. 227 have apophyseal eburnation in the fragments of lumbar vertebrae. 234's comment is missing, though it is noted in the data from WORD (2022). 334 has marked bony grooves on the distal left fibula and on the calcaneum on both it is in the area of the calcaneofibular ligament. WORD (2022) suggests that the cause may be a strain to the ligament due to the foot being forced in a lateral direction. 366 has abnormal shape of the right metatarsals with a bending S-shape, especially noticeable in the MT4. And 382 has '*strange, undulating intervertebral surface, esp. in lumbar vertebrae*' (WORD 2022), it is not quite clear what that entails.

7 Comparative Discussion

As there is a larger dataset from Nikolaikirken using percentages rather than the number of individuals will give a better understanding of how the various pathologies and conditions affected the two collections and their communities. From the London Blackfriars there are 57 *in situ* individuals while there are 106 from St. Nicholas Church, one individual makes up 1.8% and 0.9% of the collections respectively.

7.1 Pathology Comparison

The means and standard deviations given in chapter 6 show certain overall trends, like the average number of pathologies and/or conditions the individuals within a pathology or condition category had. In four of the seven categories the St. Nicholas Church collection's individuals had only one pathology or condition. However, no individuals had any circulatory and metabolic pathologies, and the collection were only affected by six of the seven categories. The London Blackfriars only had one pathology or conditions per individual in two of the seven, and the collection had affected individuals in all seven categories. The category with the largest difference between the two were the Circulatory and Metabolic pathology category where there were no cases from St. Nicholas Church, giving it an average of zero, while the average from the London Blackfriars were 1.1 pathology per individual. Though as mentioned in sections 6.1 and 6.2 of this thesis there could be more individuals who had pathologies and/or conditions but that were lost due to taphonomic processes and the preservation of the skeletons.

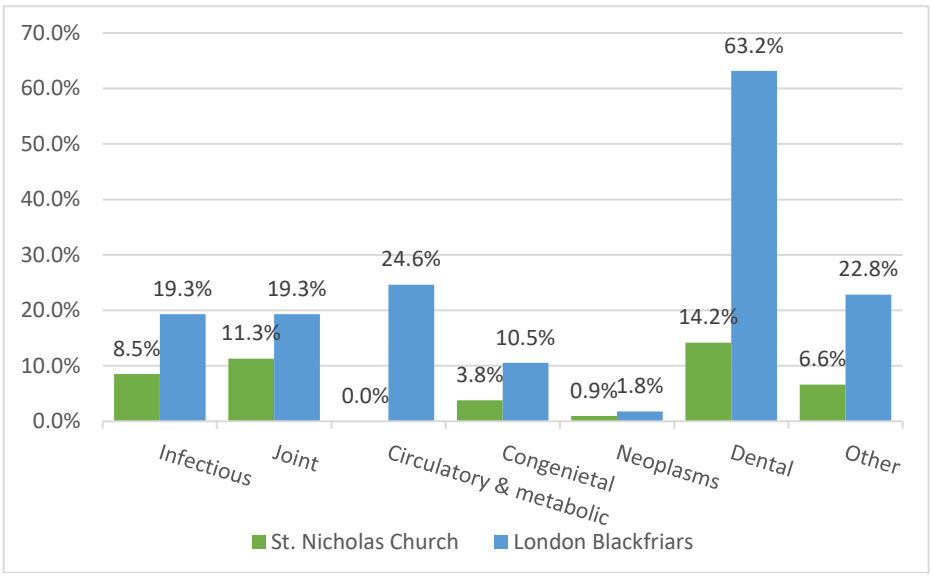

Figure 7.1 *Percentages of individuals within the different pathology categories from St. Nicholas Church and the London Blackfriars*

When looking at all the individuals with pathologies the London Blackfriars score highest with an average of 3.7 pathologies or conditions per individual, while St. Nicholas Church has 2.3 on average. Also, when looking at the percentages the individuals from the London Blackfriars score higher than the ones from St. Nicholas Church. Though as mentioned

due to there being almost twice as many *in situ* individuals from St. Nicholas Church as the London Blackfriars one individual will make up a larger percentage. This can be seen with the Neoplasms category where in both collections there is only one individual, as seen in Figure 7.1 this makes up 0.9% of St. Nicholas Church and 1.8% of the London Blackfriars.

7.1.1 Infectious

From the infectious pathologies none of the pathologies affected both collections, from St. Nicholas Church there were individuals with TB or lepra while from the London Blackfriars there were only non-specific periostitis. Overall, 8.5% of the individuals from St. Nicholas Church were affected while 19.3% of individuals from the London Blackfriars. However, TB and lepra often are more serious than non-specific periostitis and a lower percentage from St. Nicholas Church does not mean that they necessarily were 'healthier'. As TB is seen as an 'urban pathology' one would expect there to be cases from the London Blackfriars, and of all the individuals from any Medieval cemetery in WORD's database (2022) only 0.6% have been diagnosed with TB. From St. Nicholas Church 2.8% have TB, though including the individuals that possibly have TB it is 4.7%. In Medieval England they were quite strict with hospitalization of individuals with lepra, and there have been found individuals with TB from some of the hospitals (Roffey 2012:217). It is possible that the lack of skeletal involvement associated with TB is due to hospitalization of the more severe cases. The number of people with TB were likely high from both collections as skeletal involvement only occurs in 3-5%.

Non-specific periostitis is the same as primary periostitis and is relatively mild compared to the other pathologies in this category. As the skeletal lesions are the result of an infection it is obviously a severe infection which is the cause of the pathology. There is only one individual from St. Nicholas Church which likely has periostitis, this is SZ50522 who has bone changes to the left lower leg (see Figure 7.2 below). This individual has lepra and any periostitis would likely be secondary to this condition. This much more severe than any of the primary periostitis from the London Blackfriars, which cases overall appear to be mild and not to have caused any major deformities. For the most part they likely did not cause any additional problems after the initial infection had passed.

Figure 7.2 *Left fibula and tibia of SZ50522 with bone changes due to lepra. Lateral view of tibia and roughly posterior view of the fibula to show the most affected sides of both bones. Photographed with a 10cm*10cm photo scale*
Photo by Sara Georgine Fløien Schiøtz

7.1.1.1 Lepra

In the later Medieval England there were over 300 documented leper hospitals, and likely even more undocumented smaller, rural hospitals or communities (Roffey 2012:203, 213). The documented leper hospitals made up roughly one-fourth of all of the documented hospitals in England. The majority of these were founded before the 14th century when a decline started. The pathology was particularly active from 1050-1350, the plague is the most probable cause of the decline both in infected individuals and hospitals (Roffey 2012:203-207, 213).

Figure 7.3 *SZ29742's maxilla with rounding of the anterior nasal spine indicative of early RMS. There is also some minor post-mortem damage to the anterior nasal spine at the very anterior aspect, making it look slightly rounder than it is. Photographed with a 5cm*5cm photo scale.*
Photo by Sara Georgine Fløien Schiøtz

In Norway leper hospitals were less common, and the first was not founded before the 12th century in Nidaros (now Trondheim) (Vogelsang 1965:30). More leper hospitals were founded in other towns from the 13th century and on, the first mention of a leper hospital in Oslo (St. George) was in 1304. It is not known if the hospital were connected to a church or a cemetery. Another hospital in Oslo was connected to the St. Laurentius Church (Lavranskirken) and had a cemetery, from which evidence of lepers have been found. It is possible that St. George used the St. Laurentius Church's cemetery (Nedkvitne and Norseng 2000:29; Vogelsang 1965:30). Only

one of the leper individuals from St. Nicholas Church possible predates St. George. This is SZ29742 which has early RMS, see Figure 7.3, and is the only lepromatous individual. The two other certain individuals had tuberculoid lepra, and the possible case is too early to tell. As all of these three post-dates St. George's first mention it is possible that they did not have severe enough symptoms to be sent to the hospital. It is also possible that they still used the parish churches of the individuals that died at St. George for their burials, so the presence of the individuals in a 'normal' cemetery does not mean that they were not hospitalized.

As mentioned above, there were also individuals with TB, and other pathologies, identified from leper hospitals in England. There are also often individuals without any skeletal lesions, though this does not mean that the individual was not leprous. As some hospitals have a high number of young females and juveniles it has been suggested that unmarried pregnant women were sent to these hospitals (Gilchrist and Sloane 2005:206-207). The lack of individuals suffering from lepra, and possible TB, from the London Blackfriars could be due to how common leper hospitals were. There was a women's leper hospital at St. James the Less in London, which today is less than an hour's walk from the Friary (Roffery 2012:217).

7.1.2 Joints

Joint pathologies affected both collections, though following the reoccurring trend it is more common amongst the London Blackfriars collection than the St. Nicholas Church collection. Both are affected by OA, but from the London Blackfriars there is also ankylosis, DISH, and additional osteophytic lipping described as 'Joints – Other'. From the London Blackfriars the individuals with joint pathologies had 1.4 pathologies on average, standard deviation of 0.7, while as there only was one pathology from St. Nicholas Church. The category also affects more individuals from the London Blackfriars than St. Nicholas Church, 19.3% and 12.3% respectively.

The graphs representing the age distribution of the two collections (St. Nicholas Church – Jensen 2018:36, Figure 8; London Blackfriars – Bekvalac et al. 2007: Figure 2) show a relatively similar figure, St. Nicholas Church has a few more juveniles and the London Blackfriars have a large number of adults that cannot be age determined; 28.1% of all *in situ*. Though it is worth noting that from St. Nicholas Church all individuals are used, not just the *in situ*. As age is the most common factor for OA it makes sense that the two collections have similar percentages, given that they follow a similar pattern of the pathology. From St. Nicholas Church 11.3% of the individuals have OA, with one more individual possible having it, and

from the London Blackfriars 10.5% of the individuals have it. Neither population seem to be drastically more predisposed for the pathology.

As the two collections have similar age distribution and percentages of affected individuals it is worth delving further into the distribution of OA based on age in the two collections. From St. Nicholas Church all but one individual with OA is from the two oldest age groups (maturus and senilis), and from these two age groups 61.1% have OA. From the London Blackfriars 18.8% of the two oldest age group (36-45 and >46) have OA, though it is worth noting the high number of unaged adults and from that group 12.5% have OA. These three age groups make up all but one of the cases from the London Blackfriars, the last individual is the youngest individual with OA and is in the 26-35 age group. The youngest individual from St. Nicholas Church is 30-40 years, from the age group adultus. So, it appears that age is not the only factor. Secondary OA is a possibility, though it is also possible that the affected joints were under a lot of stress, e.g., doing manual labour.

As mentioned, the London Blackfriars' 'Joints – Other' category from WORD (2022) is primarily osteophytic lipping, all the cases are minor and two-thirds are described as 'slight'. The 'Possible OA' category from St. Nicholas Church could be seen as a parallel to this category, as there is only one individual who has some osteophytic formations. From the London Blackfriars this category affects 10.5% of the individuals, while the one individual makes up 0.9% of St. Nicholas Church's individuals. Only one individual from this category from the London Blackfriars also had OA, and three more also had DJD. This category can in some cases be interpreted as early stages of OA or cases where a definite diagnosis cannot be made.

7.1.2.1 Diffuse Idiopathic Skeletal Hyperostosis (DISH)

DISH is only found in the London Blackfriars collection, affecting two individuals (3.5%). Both individuals were males in the '>46' age group. 222's spine was affected from T5-T12, while with 234 they could not be certain of exactly how many vertebrae were fused due to fragmentation, but it was still clear enough for diagnosis. 222 also had ankylosis of the right sacroiliac joint and had lipping on L3-L5 and S1, it is possible that there is a connection between this and the DISH. Though this is not an interpretation mentioned by neither WORD (2022) nor Bekvalac et al. (2007). And as the left sacroiliac joint may have been in the process of fusing it is possible that the ankylosis was not necessarily an 'extension' of DISH.

7.1.3 Circulatory and Metabolic

Circulatory and metabolic pathologies is the only category which only affects one of the collections for certain, there are no certain cases from St. Nicholas Church. While 24,6% of the London Blackfriars collection were affected, with an average of 1.1 pathology per individual. The second most common pathology is osteochondritis dissecans and all the cases were to the feet; two to the 1st phalanx and one to the tarsals. There is also one individual with Freiberg's disease. Both pathologies are associated with trauma, though stress can also be the cause of Freiberg's disease. The pathologies mainly indicate that the individuals had some trauma or stress happen to their feet at one point in their lives. The bilateral 'spicular' bone growth from 'Blood – Other' could also be a result of trauma. There is not much information about any possible cause presented by neither WORD (2022) nor Bekvalac et al. (2007).

Osteoporosis is a pathology which becomes more common with age and is most commonly seen in postmenopausal women. Postmenopausal is often estimated from 50 years and up, and in modern times osteoporosis affects 30% of postmenopausal, Caucasian women in the US (Bellatoni n.d.). The one individual with osteoporosis from the London Blackfriars is a female in the oldest age group (>46 years) who had a Colle's fracture. As stated in section 4.1.3.4, none of the techniques or tools commonly used for diagnosing osteoporosis was used on the St. Nicholas Church collection. Also mentioned were the two individuals from the collection with compression fractures, one of which is a female aged 60-80 years (SZ19834). It is possible that she had osteoporosis, but a diagnosis is not certain. SZ19834 makes up 20% of all females with a minimum age of 50 years or high from St. Nicholas Church. The individual from the London Blackfriars makes up 33.3% of the >46 years females. Assuming that osteoporosis was as common in the Medieval period as it is in modern times these percentages are to be expected and does not play too much into the overall health.

While there is not one specific aetiology connected CO, it is often associated with anaemia, rickets, and scurvy (see section 4.1.3.3 of this thesis). And can therefore be seen as a marker for dietary deficiency and non-specific stress. It affects 17.5% of the individuals from the London Blackfriars and is the most common circulatory or metabolic pathology. The pathology is however not present in the *in situ* individuals from St. Nicholas Church, though only 38.7% of the individuals used in this study had any part of the frontal bone present, so it is possible that individuals with CO have been lost. If considering the possibility of lost cases of CO from St. Nicholas Church it should also be mentioned that 56.1% of the London

Blackfriars collection had any part of the frontal bone present. This changes the percentage from 17.5% of all *in situ* to 31.3% of all *in situ* with frontal bone present.

7.1.4 Congenital

Most of the congenital conditions from either collection are not necessarily connected to any health issues and might not have affected the individuals to any degree. Some of the conditions that are mainly asymptomatic are bathrocephaly and extranumary (lumbar) vertebrae, both only found in the London Blackfriars collection. The fusion of the interphalangeal joint, also known as symphalangism, occurs in both collection and all cases are of the distal interphalangeal joint. Figure 7.4 shows symphalangism of SZ15244's distal interphalangeal joints, the fusion appears to have obliterated the to a higher degree on the left where it is barely visible. There are two cases from St. Nicholas Church, both of the 5th toes, and there is one case from the London Blackfriars, making up 1.9% and 1.8% respectively. This is the only congenital condition found in both collections. Symphalangism is often asymptomatic, with stiffness of the affected joint as the most common symptom (Knipe and Bell 2022).

Figure 7.4 *Symphalangism of SZ15244's distal interphalangeal joints from both the left (left) and right (right) feet. Photographed with a 5cm*5cm photo scale, though cropped to only show 3cm*4cm*
Photo by Sara Georgine Fløien Schiøtz

The remaining cases from St. Nicholas Church is one case of spondylolysis and the one individual that is missing the right *facies articularis inferior* of the L5 where the L4's *facies articularis inferior* has elongated to compensate. How the absence of the *facies articularis inferior* affected the individual is not certain. It could have been asymptomatic, but if not likely symptoms would be stiffness or pinching of nerves which could have caused pain or affecting the mobility. Spondylolysis is in most cases asymptomatic, or only causing minor back pain. But as the individual, SZ25196, had spondylolysis of both the L4 and the L5 it is likely to have caused instability of the spine. SZ25196 has extreme osteophytic formations to most of the thoracic and lumbar vertebrae, with additional changes both to the *facies articularis superior et inferior* and the *facies intervertebralis superior et inferior*. This might have been brought on by instability caused by the spondylolysis. The individual is diagnosed with OA, and also had osteophytic formation covering large parts of the left os coxa.

The remaining cases from the London Blackfriars are two cases of CDH, one possible case of SBO, and one case of *calcaneus secundarius* with an unspecified necrotic appearing area on the calcaneus. The *calcaneus secundarius* is an ossicle associated with the calcaneus which can occur, the presence of it can be asymptomatic but it can also cause ankle pain (Dixon and Bell 2022). The necrotic appearing area on the calcaneus is probably associated with the *calcaneus secundarius*. While SBO can cause neurological symptoms, it most commonly does not and is more or less asymptomatic (Sheikh and El-Feky 2022). As the degree of CDH can vary from partial to complete dislocation the symptoms vary accordingly. In some cases it may not be discovered until early adulthood while other cases are discovered while the individual is still a child. Symptoms include immobility or reduced flexibility of the hip and limping, and it can lead to complications like early onset OA (Mayo Clinic 2022). It is commented that 306's right acetabulum and *caput femoris* are both flattened and widened while both of 504's acetabula are shallow and the left *collum femoris* is shortened. 504's comment also starts with a question mark; it is unclear what this is supposed to mean and it is possible that they are not certain if it is a case of CDH or not (WORD 2022).

7.1.5 Neoplastic

The only type of neoplasms present in either collection is osteomas, which are benign, asymptomatic neoplasms that are common in the archaeological record. There is only one individual affected from each collection, making up 0.9% and 1.8% of the individuals from St. Nicholas Church and the London Blackfriars respectively. From St. Nicholas Church it is a button osteoma located on the occipital bone while from the London Blackfriars it is an osteoma located on the tibia. They do not play much into the overall health of either collection.

7.1.6 Dental Conditions

Dental conditions are the category which affects the most individuals from both collections, though it affects the London Blackfriars a great deal more than St. Nicholas Church. As said in chapters 6.1.5 and 6.2.6, 14.2% of the *in situ* individuals from St. Nicholas Church has any dental conditions while 63.2% from the London Blackfriars. If only looking at how many of the individuals with teeth had any dental conditions, then the percentages even out a bit, but the London Blackfriars still have quite a bit higher percentage with 92.3% while St. Nicholas Church then would be at 50%. The individuals from the London Blackfriars also had more dental conditions on average than the ones from St. Nicholas Church. The mean from the London Blackfriars is 2.7 with a standard deviation of 1.1 and the median in 2.5, all of the

numbers are lower from St. Nicholas Church; a mean of 1.6 with a standard deviation of 0.9 and a median of 1.

From St. Nicholas Church the individual SZ29914's data is gathered from Jensen' osteological report (2018) as the individual's jaw is missing, see 4.2.1. The data for this individual is less detailed than the data from WORD (2022), where the number of affected teeth is clearly noted, and some cases makes it clear which teeth are involved. With SZ29914 the number of affected teeth is not noted, nor is it if it affected the maxilla or mandibula.

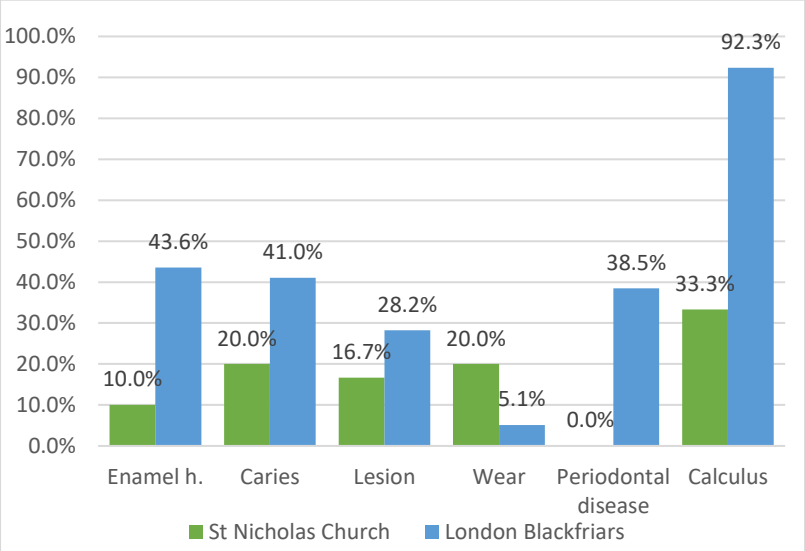

Figure 7.5 *The percentage of individuals with teeth that any of the dental conditions from St. Nicholas Church and the Blackfriars*

As seen in Figure 7.5 all the dental conditions, other than abnormal wear, affects the London Blackfriars more than St. Nicholas Church. From the London Blackfriars there are two cases of abnormal wear, both of which affect the anterior incisors. One case affects both the maxilla and the mandibula (234) while the other only affects the maxilla (227) it is not clear whether or not the mandibular incisors are present. If the mandibular incisors are present and not worn the wear would be abrasive, if they are not present it cannot be concluded if it is abrasive or attrition. From St. Nicholas Church most cases are of uneven involvement of either the maxilla and mandibula or between the right and left sides. Some unevenness can occur with attrition, and for the most part the worn teeth match up. Extreme wear of the anterior maxillary incisors is common in the St. Nicholas Church collection. With the exception of SZ29742 (who has lost them post-mortem) and SZ29914 (from which it is not known which teeth were worn) it occurs in all individuals with wear. Some of the cases are quite severe, like SZ29742 which has more or less lost the entire crown of seven teeth (maxillary right and left canines as well as both premolars and M^1 on the left side, both right premolars are lost post-mortem; and both mandibular M_1s are also worn down).

Another special case of wear from St. Nicholas Church is SZ20939, which might have abrasive wear. The maxillary incisors are all rather worn while there is little wear to the mandibular incisors. On the right side the M^1 is worn and the P^2 and M^2 show little to no wear while the right P_2, M_1, and M_2 all are worn, and more so than the M^1 is. This individual has AMTL and an abscess of the left mandibular premolars, furthermore the placement of the remaining mandibular teeth seems to have moved away from the abscess and somewhat pushing the incisors towards the left. This can be seen in Figure 7.6. This could have caused the abnormal wear, but at the very least it must have attributed to it. As well as the abscess the individual has two teeth with one cavity each, and three loose teeth also have one cavity each.

Figure 7.6 *SZ20939's mandibula with an abscess where the left premolars should be, causing AMTL. Also visible is the cavity on the left M_2's buccal aspect and abnormal wear, the wear is worse on the right side than on the left and the rather extreme wear of the right M_1 is visible. Also worth noting is the large break of the mandibula on the left side which as the colour is similar to the rest of the bone must have happened perimortem. Photographed with a 5cm*5cm photo scale.*
Photo by Sara Georgine Fløien Schiøtz

Caries is a common dental condition in modern times as well as in the past. In the US from 2015-2018 25.9% of people aged 20-44 years had caries, and 25.3% of people aged 45-64 years (National Center for Health Statistics 2019). From St. Nicholas Church 20.0% of the individuals with teeth had caries while from the London Blackfriars it was 41.0%, just over twice as much. Caries can cause alveolar lesions and 48.7% of the individuals with teeth from the London Blackfriars had one or both of the conditions. From St. Nicholas Church it was 23.3%, and it appears that the London Blackfriars collection was more predisposed for these conditions than the St. Nicholas Church collection was.

The presence of dental calculus is not uncommon, even in modern times it affects 68% of all adults according to Opencare (2020) and it is not unlikely that it was even more prevalent in ancient times. It affects 9.4% of all *in situ* individuals from St. Nicholas Church and 63.2% from the London Blackfriars. Though if only looking at the individuals with teeth it affects

92.3% of the London Blackfriars collection. The only individuals with teeth that does not have calculus are the three individuals in the age group 1-5 years. It is possible that their age is the main reason as to why they had not developed calculus. WORD (2022) notes that 241 have a build-up of calculus on the right side of the mouth and combined with the lack of wear they suggest it was caused by immobilization, possibly due to a stroke or Bell's Palsy. From St. Nicholas Church 33.3% of the individuals with teeth had calculus. The oldest individual with teeth that does not have calculus is aged 40-60 years, so there would have been time for calculus to develop. However, 18 of the individuals with teeth from St. Nicholas Church are juvenile and 12 of them are under 5 years. If adjusting for this one can see that 75.0% of all adults with teeth from St. Nicholas Church had dental calculus, meanwhile all adults from the London Blackfriars with teeth have it. And 16.7% of the juveniles over 5 years with teeth from St. Nicholas Church have it while all from the London Blackfriars have it. Of all individuals with teeth over 5 years 100% from the London Blackfriars have dental calculus, while it is 'only' 55.6% from St. Nicholas Church. Dental calculus is clearly less common amongst the St. Nicholas Church individuals than the ones from the London Blackfriars, dental calculus also appear to barely less common from St. Nicholas Church than it is in modern times. It is not uncommon that calculus affects all the individuals from an archaeological collection, so the high percentage from the London Blackfriars is not unique.

Periodontal disease is often caused by the build-up of plaque, so it is only natural that it is more common amongst the London Blackfriars individuals than it is from St. Nicholas Church. As mentioned in 6.1.6 there are two possible cases (1.9% of all *in situ*) of periodontal disease from the St. Nicholas Church collection. These could be the early stages of the pathology, but the lesions might not be caused by the pathology and are therefore not counted in Figure 7.5. From the London Blackfriars 38.5% of all individuals with teeth have the pathology. In two-thirds of the cases affect both the maxilla and the mandibula, while in 13.3% of the cases there is only involvement by one tooth.

All of the dental conditions mentioned so far follow the established trend of the London Blackfriars being 'worse off' than St. Nicholas Church. As this is especially true for the dental conditions, where all of the conditions are directly comparable between the two collections. This could both indicate that the London Blackfriars had poorer dental hygiene and that they had diets that were higher in sugars than the individuals from St. Nicholas Church.

The last dental condition, enamel hypoplasia, is not necessarily as connected to dental hygiene as the other conditions were. It is a non-specific indicator of stress that reflects the health of an individual during a specific time in their childhood. 2.8% of all *in situ* individuals from St. Nicholas Church have it and 29.3% from the London Blackfriars, though only based on individuals with teeth it is 10% and 43.6%. EH is more common amongst the London Blackfriars individuals than the St. Nicholas Church individuals. Which might indicate that the St. Nicholas Church individuals had better living conditions with less serious pathologies or periods of stress during childhood. However, it is worth noting that all the individuals with EH from St. Nicholas Church are juveniles, meaning that they did not survive childhood. As mentioned in 4.1.6.1 a lower age at death for individuals with EH is not uncommon as the period of stress that caused the EH can weaken their immune system and make them more susceptible for later stresses. Though SZ50524, a child aged 7-9, had sharp force trauma which likely was perimortem as there were no evidence of healing along the left lambdoid suture. It is possible that the deaths of the juveniles with EH from both collections had nothing to do with EH or a weakened immune system.

7.1.7 Other

The Other category is the category that is the least easy to compare, some pathologies or conditions appear in both collections while others do not. One of the pathologies that affects both collections is compression fractures affecting 1.9% of the individuals from the St. Nicholas Church collection and 1.8% of the individuals from the London Blackfriars collection. One of the individuals from the St. Nicholas Church collection (SZ19834) might have had osteoporosis, as mentioned in 7.1.3. The other individual from the St. Nicholas Church collection is a possible female aged 40-50 years, this age could be postmenopausal but could also be pre-menopausal and compression fracture can have other causes than osteoporosis as well.

Another pathology that appears in both is abnormal bone formation and bony growths. Cases of osteophytes and lipping not noted in the Joint category, meaning that they do not primarily affect joints, are also added here. This affects 4.7% from St. Nicholas Church and 8.8% from the London Blackfriars, osteophytes and/or lipping makes up 1.9% and 5.3% respectively. In most of the cases the bone formation is not major, though would likely have caused pain, stiffness, and/or discomfort to the individuals. The most extreme case of abnormal bone formation is SZ19834 from St. Nicholas Church, which has excessive bone formation on

two metacarpophalangeal joints. The exact cause of this bone formation is not known, though it could be from an infection.

Abnormal bone loss also occurs, though this is only noted in the St. Nicholas Church collection. It affects 3.8% of the *in situ* individuals and 75% of the cases are in association with abnormal bone formation. The last individual, SZ18421, only has bone loss, which is quite minor and only affects the clavicles. The individual has over 90% of the post-cranial skeleton preserved and the bone loss is the only lesion to the post-cranial skeleton.

There is one case of Paget's disease from the London Blackfriars collections, affecting the parietal and occipital bones making them thick and dense. If the bone encroached on the intercranial space and, if so, how much is not specified by WORD (2022). As an aetiology is not known it cannot be certain what the implications of the pathology was for the community. Paget's disease has both been linked with genetic mutation and with viral infections.

Under the 'General Pathology Comments' from the London Blackfriars collection enlarged muscle attachment of two individuals (3.5%) is mentioned, and according to WORD (2022) one of them has '*strange muscle attachments*' at the supraoccipital. There are also two individuals (1.9%) from the St. Nicholas Church collection that have enlarged muscle attachments. This has not been mentioned previously as it can be debated whether or not it counts as pathology. All cases could be due to the individuals having done a lot of manual labour.

Enthesopathies affect 5.3% of the individuals from the London Blackfriars. Enthesopathy is the development of enthesophytes at the site of attachment for tendons or ligaments and is caused by repetitive mechanic stress or as a response to a general inflammation of the area. They can be confused with osteophytes (Hacking and Bell 2022). There are no certain cases of this from the St. Nicholas Church collection, though three individuals (2.8%) have osteophytes on the anterior aspect of their patellae. All three also have OA. None of the individuals from the London Blackfriars collection had OA.

The remaining conditions from the St. Nicholas Church collection is one individual with a depression on the pubis symphysis likely connected to pregnancies. And one individual with an odd shape to the T5-T7, possibly also T4 and T8, which could have caused a slight curve to their spine, this could be congenital. From the London Blackfriars collection there was one individual with abnormal shape of the right metatarsals, it is uncertain if this is associated

with a pathology, trauma, or if it is simply congenital. And one last individual which does not have a comment but still is in the General Pathology Comments category.

7.2 Overall Health

As already stated, there is a clear trend of the various pathologies and conditions being more common amongst the London Blackfriars individuals than the St. Nicholas Church individuals. Overall 80.7% of the London Blackfriars collection have any pathology or condition while 28.3% from the St. Nicholas Church collection had. On average the individuals from the London Blackfriars have 1.3 more pathologies and/or conditions than those from St. Nicholas Church, the standard deviation is also 1 more than from St. Nicholas Church. So not only is a larger percentage of individuals affected by various pathologies and conditions each individual also have more pathologies and conditions. Those that develop lesions are those that survive the stress for a prolonged period and might be the less frail individuals from a population, though this interpretation might not fully apply to the London Blackfriars.

Both enamel hypoplasia and cribra orbitalia are associated with dietary deficiencies and non-specific stress, and both commonly form during childhood. While EH exclusively form during childhood CO can also from during adulthood, though it most commonly forms during childhood and early adulthood. EH is more common from the London Blackfriars than from St. Nicholas Church and CO only occurs in the London Blackfriars collection. The stress that caused EH can weaken the immune system and heighten the individual's risk of death. This could be the reason why all three individuals with EH from St. Nicholas Church died while still juvenile, though one had evidence of sharp force trauma to the skull (see section 7.1.6 of this thesis). From the London Blackfriars 17.6% of those with EH were juveniles. Though the childhood mortality was similar from the two collections, 15.8% of the *in situ* individuals from the London Blackfriars are juvenile and 17.0% of the *in situ* individuals from St. Nicholas Church are, and of the juveniles 42.9% and 16.7% from the collections had EH. And while it was only those three juveniles from St. Nicholas Church, making up 10.0% of *in situ* individuals with teeth, it was much more common amongst the London Blackfriars collection, 43.6% of *in situ* individuals with teeth.

Cribra orbitalia does not occur in the *in situ* material from St. Nicholas Church, though there are seven cases amongst the *ex situ* material (see Jensen 2018:43 for more). And while only the *in situ* material is being studied for this thesis it is worth noting that the pathology did

occur in the population as it is possible that some of the *in situ* individuals had CO, but the frontal bone is not preserved. However, even so CO is much more prevalent amongst the London Blackfriars collection, where it occurs in 17.5% of the *in situ* population and in 31.3% of the *in situ* population with preserved frontal bones. Of the individuals from the London Blackfriars with EH and/or CO 28.6% have both, though the majority only have EH (52.8%).

From both collections the pathology/condition category which affects the most individuals is the Dental Conditions. This category has already been discussed at length in section 7.1.6 of this thesis. While when it comes to skeletal involvement individuals with more lesions might be healthier than those with few, this is not the case with dental conditions. And based on the surviving material the London Blackfriars had more cases of dental conditions than St. Nicholas Church. The high number of individuals with dental calculus, caries, and periodontal disease, combined with the presence of DISH, which is associated with obesity and type 2 diabetes, creates a pattern of a diet more likely to cause dental conditions and pathologies from the London Blackfriars.

Tuberculosis and lepra only occurred in the St. Nicholas Church collection, and it is easy to understand why there were no cases of lepra from the London Blackfriars though the lack of TB is harder to explain. In England they were quite strict when it came to lepra and had managed to eliminate the pathology by the 16th century, and it was already becoming rare in the 15th century (Roberts and Manchester 2005:204). While in Norway the pathology was still present until the 20th century. From the first 'reliable consensus of lepers' in 1856 roughly 0.2% of Norway's population had lepra and it steadily declined until only there were only seven lepers in 1957 (Vogelsang 1965:32-35).

Most of the remaining pathologies and conditions either do not have any abnormal patterns or are not comparable. The osteomas and the, possible, osteoporosis both are to be expected, and so is most of the OA. The most unusual joint pathology is the ankylosis of the sacroiliac joint of one of the individuals with DISH from the London Blackfriars. Though there is no interpretation or a more detailed explanation from WORD (2022) which makes it hard to identify fully what it would have entailed for the individual. The congenital conditions are for the most part asymptomatic, and apart from symphalangism, none of them occur in both collections. There are some cases, such as the Paget's disease, which are more severe but there is not much more to discuss that has not already been covered.

Non-specific periostitis is the remaining pathology that can indicate any major differences between the two collections. This pathology affects roughly one-fifth of the individuals from the London Blackfriars, while the only certain case from St. Nicholas Church is secondary periostitis in association with lepra. While all the cases of non-specific periostitis from the London Blackfriars are quite minor when it comes to the level of skeletal involvement the cause of the pathology is a severe infection. It is possible that this pathology does not occur from St. Nicholas Church because they would not survive the infections, but I do not think this is the case. Another cause could be that the London Blackfriars were more prone to trauma, stress, and ulcers which can be causes of periostitis. The most commonly affected bone is the tibia, which is affected in 45.5% of the cases. Individuals with diabetes, high blood pressure, or who are obese are more at risk of developing leg ulcers (Healthdirect 2021). Both of the individuals with DISH had non-specific periostitis on the tibiae. Other possibilities include that the London Blackfriars were more prone to infections due to the sanitation of the town it was harder to keep it clean. As covered in section 2.1.4 water contamination was a larger problem in Medieval London than in Medieval Oslo, where it was required by law to have access to clean water. This does not mean that all trauma from St. Nicholas Church was perfectly dealt with and not causing any lasting damage as the abnormal bone formation to SZ19835's metacarpophalangeal joints could be due to an infection, amongst other possibilities.

7.3 Further Research

The osteological analysis done in this thesis has been non-destructive, though by using destructive analyses one can shed further light on the health and living conditions of an archaeological collection. NIKU has done some destructive analyses and additional sample taking from St. Nicholas Church (see section 3.1 from Jensen 2018). They sampled nine individuals from the collection to see if they could identify *Yersinia Pestis*, the bacterium that causes the plague, and the bacterium was found in one individual (Namouchi et al. 2018). The identification of other bacteria through aDNA (ancient-DNA) is something that could be looked into, as it can identify pathologies that do not leave skeletal lesions and it can identify the exact strain of bacteria which can be used to understand the spread of bacteria and their evolution. Also useful are isotope analysis, and especially by studying the diet can living conditions and social differences be better understood. NIKU has taken isotope samples from the St. Nicholas Church collection, but not analysed them (Jensen 2018:27, 55).

8 Conclusion

This thesis had as a goal to better understand the health and living conditions in Medieval Oslo, and how the size of a Medieval town affects the health of the inhabitants. Overall based on these two collections Oslo appears to have been a healthier town than London during the Medieval period. The percentage of individuals from the London Blackfriars who had any pathology or condition presenting on the skeleton were over three times as high as the percentage of individuals from St. Nicholas Church. And they also on average had more pathologies and/or conditions per individual than the individuals from St. Nicholas Church had. However, more skeletal lesions do not necessarily equate worse health. The two collections have similar age distributions, likely having similar life expectancies. This can be interpreted in a couple of different ways, but in all cases it supports that the London Blackfriars survived multiple stresses in their community. From St. Nicholas Church this could either mean that they did note experience the stresses or that the individuals were on the extremes on the immune response spectrum, either dying before skeletal lesions could develop or that the immune response warded off the stress. It is also worth noting that the numbers might not be representative of the entire population, both as taphonomic process might have destroyed parts of the skeletons and as the section of the cemetery the individuals are from might be non-representative of the population as a whole.

With the exception of the infectious pathologies the St. Nicholas Church collection appears to have been a relatively healthy population. The cases of TB and lepra, both the certain and the probable, make up less than one-tenth of the *in situ* individuals but as there is usually only skeletal involvement in 3-5% of the individuals with either pathology it is not unlikely that there were even more individuals with the pathologies from the community. The lack of these pathologies from the London Blackfriars could also be explained by the rarity of skeletal involvement. Though as covered in section 7.1.1.1 leper hospitals were quite common in England at the time it is not unlikely that individuals with these pathologies from the London Blackfriars were hospitalized. The cemetery belonging to the London Blackfriars was at the earliest in use from 1200, which is just a couple hundred years before lepra was eradicated in England. So the pathology was likely rare during the cemetery's period of use.

Furthermore, it is not unlikely that both individuals with mild lepra and TB from Oslo used the 'legd'-system, which primary function was to take care of the 'poor'. If this was the case this might have worked as to spread contagious pathologies within the community. It would also explain why these pathologies are more common from St. Nicholas Church as the

individuals still were part of society in a sense, while from the London Blackfriars they were more removed from the society and placed in hospitals. It is also worth noting that St. George, the leper hospital in Oslo, does not have a known cemetery and it is possible that individuals that died at the hospital was still buried in their parish church's cemetery.

The low occurrence of EH combined with no cases of CO from St. Nicholas Church indicate a low number of stresses and dietary deficiencies during childhood and early adulthood. There is the chance that individuals exposed to the stresses that would lead to CO or EH died before they could manifest in the skeletal remains. But as there do not appear to be a much higher childhood mortality from the St. Nicholas Church collection than from the London Blackfriars collection a healthy childhood is the more probable reason. Especially as it has been suggested that the section of the cemetery the St. Nicholas Church collection is from was originally reserved for women and children. If this was the case there would be a higher percentage of juveniles in this section of the cemetery than it would be from the whole cemetery, it is possible that the childhood mortality is lower than what it appears from this section. The childhood living conditions appear to have been better in Oslo than in London, this might in part be due to Oslo not conforming to the Christian diet and access to clean water being required by law. From the London Blackfriars there is over four times as high a percentage of individuals with EH as there is from St. Nicholas Church, and roughly a third of the individuals have CO. Other pathologies associated with dietary deficiencies and non-specific stress, such as rickets and scurvy, are missing from both collections. And it appears that dietary deficiencies and stress were more common amongst the London Blackfriars collection.

All the dental conditions, with the exception of abnormal wear, are more common from the London Blackfriars than from St. Nicholas Church. A difference in either diet, attitude towards dental hygiene, or both is most likely the reason. This is clearly seen with dental calculus, where the only individuals from the London Blackfriars which do not have it are three juveniles in the age group of 1-5 years and calculus might not have had time to develop due to their age. And even when adjusted for individuals over 5 years the London Blackfriars barely have less than twice the amount of what St. Nicholas Church have. And St. Nicholas Church have a percentage of involvement of both dental calculus and caries which is similar to the modern examples given, while the London Blackfriars have quite a higher percentage.

The presence of DISH and the prevalence of non-specific periostitis of the tibiae combined with the dental conditions might shed a light on the diet from the London Blackfriars. Both DISH and leg ulcers, which might cause non-specific periostitis, are associated with type 2 diabetes and obesity, though leg ulcers are also associated with type 1 diabetes. Type 2 diabetes and obesity can both be associated with a diet high in sugars and carbohydrates, which also can be the cause of both caries and dental calculus. And as stated the cases of EH and CO might indicate dietary deficiencies. All of this points toward a diet that in modern times might not be considered healthy. And all of these pathologies and conditions are less prevalent from St. Nicholas Church supports that the two towns had different diets which might be part of the reason as the difference in prevalence of the various pathologies and conditions.

In the other categories the two collections both follow somewhat excepted patterns and do not differ too much. One interesting example of this is the symphalangism where both collections have almost the same percentage, though this is a congenital condition which might not even have been known by the individuals who had it. It is also technically not expected but forms similar patterns. Both the cases of osteoporosis and the patterns of osteoarthritis are similar in who they affect and follow expected patterns.

The population density and the sanitation could be part of the reason as to the difference between the two towns. As covered the prevalence of non-specific periostitis from the London Blackfriars could be related to contaminated water. Ingestion of contamination water can make you ill, if not necessarily with a pathology with skeletal involvement the illness can weaken your immune system or lead to said pathologies in other ways. Medieval Oslo was less than one-tenth of Medieval London's size and the sanitation of a smaller town would be easier than a larger one, and general pollution might also have affected the health of the inhabitants. And based on population estimations Medieval London had around 25 times as many inhabitants as Medieval Oslo had during the height of their populations. London would have had a higher population density. The population density, the known problem of water contamination, and the possibility of worse sanitation from London than from Oslo could all play a part in why the London Blackfriars had more skeletal lesions. These three factors could also all explain the stresses which seem more common during the childhood of the London Blackfriars than during the childhoods from St. Nicholas Church. Based on this it is not unreasonable to conclude that the size of the two towns and their differences in diets are the main reasons behind the difference in prevalence of pathologies. And that the size of the town affected its inhabitants health and living conditions.

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10 Appendixes

Appendix A – Abbreviations

Institution abbreviations

ADBOU – Unit of Anthropology, Department of Forensic Medicine, University of Southern Denmark

DSS – De Schreinersk samlinger (*The Schreiner Collection*).

FEK – De nasjonale forskningsetiske komiteene (*The Norwegian National Research Ethics Committee)*

NESH – Den nasjonale forskningsetiske komité for samfunnsvitenskap og humaniora (*The National Committee for Research Ethics in the Social Sciences and the Humanities*)

NIKU – Norsk institutt for kulturminneforskning (*The Norwegian Institute for Cultural Heritage Research*)

WORD – Wellcome Osteological Research Database

Pathology abbreviations

AMTL – Antemortem Tooth Loss

CDH – Congenital Dislocation of the Hip

CEJ – Cementoenamel Junction

CO – Cribra Orbitalia

DISH – Diffuse Idiopathic Skeletal Hyperostosis

DJD – Degenerative Joint Disease

EH – Enamel Hypoplasia

LEH – Linear Enamel Hypoplasia

MNI – Minimum Number of Individuals

OA – Osteoarthritis

PH – Porotic Hyperostosis

RMS – Rhinomaxillary Syndrome

SBO – Spina Bifida Occulta

TB – Tuberculosis

Appendix B – Tables from Jensen (2018)

As Tables 8 and 9 from Jensen (2018) are quite relevant for the thesis they have been recreated here with permission from NIKU. The original tables are in Norwegian and here they have been translated by the me.

Table 8 from Jensen (2018)

'Table 8: Overview of the registered dental conditions, pathology, as well as trauma and injuries for all individuals in the areas Klypen Øst and Saxegaardsgata 15'. The table can be found on pages 38-39 in Jensen (2018). The numbers in brackets show the severity of each individual' from Jensen (2018). '*The pathologies and anomalies that are poorly represented in the material from Nikolaikirken's cemetery are placed under the category 'Other*' in the table […]*' (Jensen 2018:38, author's translation). The abbreviation for some of the pathologies are used to save space and with the exception of TB were not used in the original table.

Table 10.1 *Recreation and translation of Table 8 from Jensen (2018). Recreated with permission from NIKU*

	Dental conditions					**Pathology/osteological changes**					**Trauma**				
	EH	Carries	Calculus	Wear	Other*	Lepra	TB	OA	CO	Other*	Sharp	Blunt	Projectile	Fracture	Other*
In situ															
SZ13199								1(1)							
SZ13206										1(1)					
SZ15261								1(1)							
SZ13453														1(1)	
SZ14571		1(2)	1(1)		1(1)					1(1)					
SZ14604	1(1)	1(1)	1(1)				1(1)	1(1)							
SZ15557														1(1)	
SZ15919								1(1)							
SZ17787										1(2)					
SZ17909								1(3)		1(1)					

SZ18395	1(1)														
SZ18421		1(1)													
SZ19170					1(1)	1(1)?				1(1)				1(1)	
SZ19834						1(2)		1(3)		1(1)					
SZ20283										1(2)					
SZ20693							1(1)								
SZ23815								1(2)							
SZ23869										1(1)				1(1)	
SZ24142														1(2)	
SZ25196								1(3)							
SZ29742								1(1)							
SZ29914					1(3)										
SZ30577		1(1)	1(2)												
SZ50507										1(1)					
SZ50522			1(1)			1(3)								1(1)	
SZ50524	1 (1)		1(1)												
SZ50577						1(2)									
Ex situ								2		7				3	
Bone pit	3	7	6	3	8		1	3	7	7	9	1	2	1	1
Loose finds	1	1			1		2				1	1	1		
Total	7	12	11	3	14	2	5	17	7	23	10	2	4	10	1

Table 9 from Jensen (2018)

'Table 9: Skeleton list, *in situ* individuals' can be found on pages 62 through 69 in Jensen (2018). It has been recreated and translated by the me with permission from NIKU. In the table double graves are marked with a green colour. The ages 7mths(f) refers to 7 months before birth.

Table 10.2 *Recreation and translation of Table 9 from Jensen (2018). Recreated with permission from NIKU*

SA-no.	SZ-no.	Sex	Age interval	Average age at death	Arm placement (Right/left)	Quan. Preser-vation	Qual. Preservation	Grave type	Femur length (cm), dx	Length measured in grave (cm)	Pathology/ osteological changes	Special
Klypen Øst												
12821	12822	4	6-8	7,00	C/C	1/3-2/3	Good	Without coffin	24	107		
13047	13049	7	35-45	40,00		1/2	Medium	Without coffin	35			
13067	13081	4	13-15	14,00		1/3-2/3	Medium	Without coffin				
13192	13199	1	50-70	60,00	C/D	1/3	Medium/ Good	Without coffin			Osteoarthritic changes to the lumbar and lower thoracic vertebrae. Schmorl's nodes.	
13205	13206	7	22-30	26,00	C/C	>2/3	Good	Without coffin	40		Tuberculosis related changes to the thoracic and lumbar vertebrae	Amulet/ 'Alsen-gemme' found by upper arm.
13226	13227	7	18-21	19,50		<1/3	Good	Without coffin				
13243	13249	4	2-6	4,00		<1/3	Poor	Without coffin				
13433	13439	4	30-50	40,00		<1/3	Good	Without coffin				
13452	13453	7	18-25	21,50		<1/3	Goof	Without coffin			Isolated, healed fracture to upper 2/3 of left fibula	
13497	13507	5	16-20	18,00		<1/3	Medium	Without coffin				
13611	13626	6	21-28	24,50	?/C	1/3-2/3	Medium	Without coffin	42	98		
13642	13643	4	9-11	10,00		1/3-2/3	Good	Without coffin	31			
13728	13803	4	1-2	1,50		1/3-2/3	Poor	Without coffin	12			
14500	14501	4	7,5-9,0	8,25	D/D	>2/3	Good	Without coffin	28 (sin.)	116		
14557	14571	6	50-65	57,50	C/C	>2/3	Medium	Without coffin	44		Abscess by both 6-year molars in the upper jaw, possible abscess/tumour to os occipital	
14590	14604	2	30-40	35,00	B/B	>2/3	Good	Without coffin		173	Possible changes to the bone tissue in the thoracic vertebrae and clavicle compatible with tuberculosis.	

											Osteoarthritic changes to the thoracic vertebrae. Strong muscle attachment in the upper arm (m. brachialis) – largest on the right. Dental wear is more prominent on the left side.	
14676	14677	4	1-2	1,50		1/3-2/3	Medium	Without coffin	12 (sin.)			
14697	14702	4	7mths(f)-0,25	0,00	C/B	>2/3	Good	Without coffin	9 (sin.)	61		Twin grave
14697	14699	4	0-6mths	0,25	C/?	>2/3	Good	Without coffin	9 (sin.)	61		
15234	15244	7	50-70	60,00		1/3-2/3	Medium	Shroud (?)	40			
15260	15261	4	45-60	52,50		1/3-2/3	Good	Without coffin			Osteoarthritic changes to the lumbar and lower thoracic vertebrae. Schmorl's nodes. Enlarged foramen nutricium above facies auricularis	
15284	15286	1	55-70	62,50		1/3-2/3	Good	Without coffin	49			
15312	15313	4	0-6mths	0,25	D/C?	1/3-2/3	Medium	Without coffin				
15372	15373	4	0-6mths	0,25	D/D?	<1/3	Medium/ Poor	Without coffin				
15453	15460	4	8-10	9,00		<1/3	Medium	Without coffin				
15485	15487	4	9-11	10,00		1/3-2/3	Good	Without coffin	30,5 (sin.)			
15521	15522	4	6-8	7,00	D/D	1/3-2/3	Poor	Without coffin				
15547	15557	6	40-55	47,50		<1/3	Medium	Without coffin			Destruction as well as additional bone formation on facies pastellaris right and left side; Possible TB.	
15690	15696	4	25-50	37,50		<1/3	Medium	Without coffin				
15918	15919	1	40-50	45,00	?/C?	1/3-2/3	Good	Without coffin	46			
15971	15972	4	9-11	10,00		1/3-2/3	Good	Shroud/coffin (?)	26 (sin.)			
15992	15998	4	0 - 1	0,50		1/3	Medium	Without coffin				
16239	16253	4	4,5-6,5	5,5	D/D?	>2/3	Good	Without coffin		87		Has been combined with graves

												SA15941 SA16799
16799	16807	4	0,5-1,2	0,85		1/3-2/3	Good	Without coffin				Has been combined with grave SA16939
16885	16886	3	18-25	21,50		<1/3	Good	Without coffin				
17786	17787	3	28-40	34,00	B/?	1/3-2/3	Poor	Shroud			Changes in bone tissue of both fibulae compatible with lepra	
17844	17864	7	50-70	60,00	D/D	1/3-2/3	Medium	Without coffin				
17961	17993	5	35-55	40,00		<1/3	Good	Without coffin				
17978	17909	7	50-65	57,50	C/C	>2/3	Medium	Without coffin			Osteoarthritic changes to the lumbar and lower thoracic vertebrae	Has been combined with grave SA50521
18111	18118	5	23-50	26,50	D/?	<1/3	Good	Without coffin				
18318	18327	5	40-60	50,00		<1/3	Medium	Without coffin				
18377	289547	4	5-9	7,00		<1/3	Medium	Without coffin				
18377	18421	2	35-45	40,00	D/C	>2/3	Good	Coffin (?)	44	169	Marked muscle attachments on right and left femora, os coxae, and upper arms. Carries	
18878	18879	4	0-1	0,50		>2/3	Good	Without coffin	8,5	53		Hocker position
19169	19170	2	55-70	62,50	B/B	>2/3	Medium	Without coffin	48	170	Possible lepra on the left fibula. Uneven dental wear on right and left side. Unsymmetrical position of the teeth. Anormal dental eruption	Stone in mouth
198	19994	4	7mths(f)-0,00	0,00		>2/3	Medium	Without coffin				
19819	19827	4	6mths-1,5	1,0		<1/3	Medium	Without coffin				
19833	19834	6	60-80	70,00	C/C	>2/3	Good	Shroud			Osteoarthritic changes in the lumbar and lower	

										thoracic vertebrae as well as the fingers. Compression fracture T12 and L1. Ossification of ligament longitudinale anterius. Unexplainable growth on the right tibia. Extreme dental wear. Dental calculus.	
19978	19987	5	17-25	21,00		<1/3	Good	Without coffin			
20245	20257	4	7mths(f)-0,25	0,00		1/3-2/3	Good	Without coffin			
20245	20255	5	24-40	32,00		<1/3	Good	Without coffin			
20281	20283	5	40-5	45,00	C/?	<1/3	Good	Without coffin			Fracture/collapse of T7. Extreme osteophyte formation on T6 and T8. Ossification of ligaments on vertebrae. Enlarged foramen nutricium[1] on thoracic and lumbar vertebrae
20345	20347	7	22-28	25,00	C/C	1/3-2/3	Good	Without coffin			
20368	20369	4	7mths(f)-6mths	0,15		>2/3	Poor	Without coffin	9	51	Oldest skeleton in the cemetery $11^{th}/12^{th}$ century
20546	20763	3	22-28	25,00		<1/3	Good	Without coffin			Unexplainable thickened small (11x45mm) area on left fibula
20572	20585	7	22-30	26,00		<1/3	Good	Without coffin	40,5		
20681	20693	6	32-42	37,00		1/3-2/3	Good	Without coffin	44,5		Tuberculosis related changes to os coxae
20786	20788	4	25-40	32,50		<1/3	Medium	Without coffin			Has been combined

										with grave SA22688
20930	20939	2	40-60	50,00		<1/3	Good	Without coffin	Carries. Tooth loss and beginning remodelling of the alveolar bone. Extreme dental wear.	
21065	21066	4	2-4	3,00		<1/3	Good	Without coffin		
21073	21079	4	4-6	5,00		<1/3	Medium	Without coffin		
21197	21203	5	30-55	42,50		<1/3	Good	Without coffin		
21233	21234	5	25-32	28,50		<1/3	Good	Without coffin		
21309	21310	5	35-55	45,00		<1/3	Good	Without coffin		
22555	22556	5	30-40	35,0		<1/3	Good	Without coffin		
22711	22712	5	28-40	34,00		<1/3	Medium	Without coffin		
22738	22739	4	6-8	7,00		<1/3	Good	Without coffin		
22774	22781	4	10-13	11,50		<1/3	Good	Without coffin		
23141	23152	5	21-28	24,50		1/3-2/3	Good	Shroud (?)		
23182	23191	4	25+	25		<1/3	Poor	Without coffin		
23806	23815	4	30-50	40,00		1/32-/3	Good	Without coffin	Osteoarthritic changes in toes on right and left foot.	Has been combined with grave SZ23983
23858	23869	7	30-45	37,50		1/3-2/3	Medium/ Poor	Without coffin	Simple healed fracture on rib no. 10 right side. Enlarged foramen nutricium on lumbar and thoracic vertebrae. Depressions on the pubis possible as a result of multiple births.	
24133	24142	4	35-45	40,00	?/D	1/3-2/3	Medium/ Poor	Without coffin	Healed fracture on three ribs on the right side	Has been combined with graves SA24454 SA23856
24281	24292	3	28-40	34,00		1/3-2/3	Good	Coffin (?)		Impression of copper at the distal

												end of left femur
24456	24462	4	7mths(f)-0,0	0,0		<1/3	Good	Without coffin				
24491	24497	4	6mths-1,5	1,00		<1/3	Medium	Without coffin				
24521	24522	4	20-40	30,00		<1/3	Good	Without coffin				
24633	24642	5	40-60	50,00		<1/3	Good	Without coffin				
24731	24737	4	20+	20		<1/3	Medium	Without coffin				
24575	24780	4	3,5-5,5	4,50	C/C	>2/3	Good	Coffin (?)				Has been combined with grave SA25000
25146	25196	2	65+	65+	C/C	>2/3	Good	Coffin (?)	48	144	Osteoarthritic changes in cervical and thoracic vertebrae; eburnation, osteophyte formation, and Schmorl's nodes.	
25321	25331	4	6-8	7,00		1/3-2/3	Good	Without coffin				
25395	25410	4	7-9	8,00	C/C	1/3-2/3	Good	Without coffin	29,5			
25530	25541	4	30-50	40,00		<1/3	Good	Without coffin				
28724	28737	4	30-50	40,00		<1/3	Medium	Without coffin				
50002	50003	4	25-32	28,50		<1/3	Good	Without coffin				
50331	50332	5	30-40	35,00		<1/3	Good	Without coffin				
50351	50362	4	11-15	13,00	D/C	>2/3	Good	Without coffin				Has been combined with graves SA22753 SA22989
50497	50507	6	28-35	31,50		<1/3	Good	Without coffin			Anomality on L5: missing inferior facet. L4 has twice as large facet to cover the missing facet on L5. Crooked proc. Spinousus L4	
50519	18395	4	1-3	2,00		<1/3	Poor	Without coffin				The
50519	50520	7	22-28	25,00		1/3-2/3	Good	Without coffin				female's

												hand is resting on the child's head
50521	50524	4	7-9	8,00	D/D	>2/3	Good	Coffin (?)	30	115		
50521	50522	7	28-35	31,50	D/C	>2/3	Good	Coffin (?)	50	175	Changes compatible with lepra on both fibulae, tibiae, and metatarsals. Healed fracture on the right tibia	
50530	50539	4	8-10	9,00		1/3-2/3	Medium	Without coffin				
51033	51044	4	7-9	8,00		1/3-2/3	Medium	Without coffin				
Saxegaardsgata 15												
28626	28627	2	40-50	45,00		1/3-2/3	Medium/ Poor	Without coffin				
29740	29742	6	40-50	45,00	?/D	1/3-2/3	Poor	Without coffin			Osteoarthritic changes in the thoracic vertebrae; eburnation on the facets	
29913	29914	7	60-80	70,00	C?/D	1/3-2/3	Poor	Without coffin			Extreme dental wear and dental calculus	
30136	30137	3	22-30	26,00		<1/3	Medium	Without coffin				
30154	03158	7	60+	60+	C/C	1/3-2/3	Poor	Without coffin				Fudge like consistency
30512	30577	2	25-35	30,00	C/C	>2/3	Poor	Coffin (?)			Dental calculus	
30513	30634	5	25-50	37,50	?/D	<1/3	Medium	Without coffin				
30668	30672	5	22-30	26,00		1/3-2/3	Poor	Without coffin	39			
30855	30870	4	3-5	4,00	C/C	>2/3	Good	Without coffin	20	91		
30855	28037	7	22-30	26,00	?/C	>2/3	Good	Without coffin	39			'Baksthelle' between the pelvic area of the female and the child's head
31019	31020	5	35-45	40,00	?/C	1/3-2/3	Poor	Without coffin				
Empty graves												
27086	EMPTY											Only empty grave

Not-excavated *in situ* graves in the eastern profile area Klypen Øst
27414
27443
27640
27634
27423

'*The positioning of the arms within each grave were recorded. Lars Redin (1976) introduced a relative chronology for these different arm positions. The earliest arm position (A) comprised both arms lying straight down at the sides and was estimated to have been used in the period AD 1000–1250. This was followed by position B where the hands were clasped over the pelvic area (1250–1350). Between 1350–1450 the arms were folded over the chest (C) and between 1450–1500 the arms were crossed over the chest with both hands resting below the opposite shoulder (D).*' (Derrick 2018: 196).