LUND UNIVERSITY

LEPROSY IN MEDIEVAL HELSINGBORG

An Osteological Analysis of the St Clement Cemetery

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Thank you…

Anna Tornberg
for many interesting discussions and fantastic supervision

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for your enthusiasm and for sharing your knowledge about leprosy

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for giving helping me with the material and giving me a place to work

Abstract

The aim of this study was to investigate the presence of leprosy at the medieval cemetery if the St Clement church in Helsingborg. The material was excavated during 1958-1962 by Margareta Weidhagen-Hallerdt, however the results from the excavation was not published until 2010. New excavations were performed during the late 1980s and the results from the osteological analysis, which was conducted by Caroline Arcini (1999), showed that five individuals were infected with leprosy. This study investigates however leprosy is present in the material from the 1958s excavation and if infected individuals were buried close to the church as well as in the periphery. It is also investigated however socioeconomic differences occurs between individuals that show evidence of leprosy and those who don't, which is reflected in stature, grave type and grave topography. The results from this analysis showed that two adult individuals, one male and one female, were infected with leprosy, and both individuals showed skeletal changes in the rhinomaxillary area. The male, dated to the 13th century, was buried in an earth grave in the periphery of the cemetery and was 3 cm shorter than the average height among males. The female can be dated to either the 11th-12th century or the 13th century and was buried in a grave with a carved sandstone next to the head. Her grave was placed within 5 m from the church. We can, from this study, see that individuals who were infected with leprosy could be buried in the periphery, as well as closer to the church. It is suggested that leprosy did not necessarily affect social status in medieval Helsingborg. Although, it is clear that leprosy affected individuals with both a higher and a lower social status.

Keywords: Osteology, Human Osteology, St Clement, Helsingborg, Medieval, Leprosy

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1. Introduction

Helsingborg was founded during the 10th century when Denmark was united under one king. The city is situated in the north western part of Scania where the strait Öresund is at its narrowest, which is a reason for why the city was one of the most important stronghold in Sweden and Denmark for centuries. The original medieval cityscape was defined by three plateaus, which were outlined by water filled valleys. These were important passage ways from the surrounding landscape, into the city and out in Öresund. The passage ways are still marked in the modern city. The city's name Halsingburg is believed to originate from the old Swedish words halsing, which would translate to neck and mean the narrowest part of the strait, and burg, which is the old word for castle and could imply an early castle or the tree plateaus (Weidhagen-Hallerdt, 2010:11).

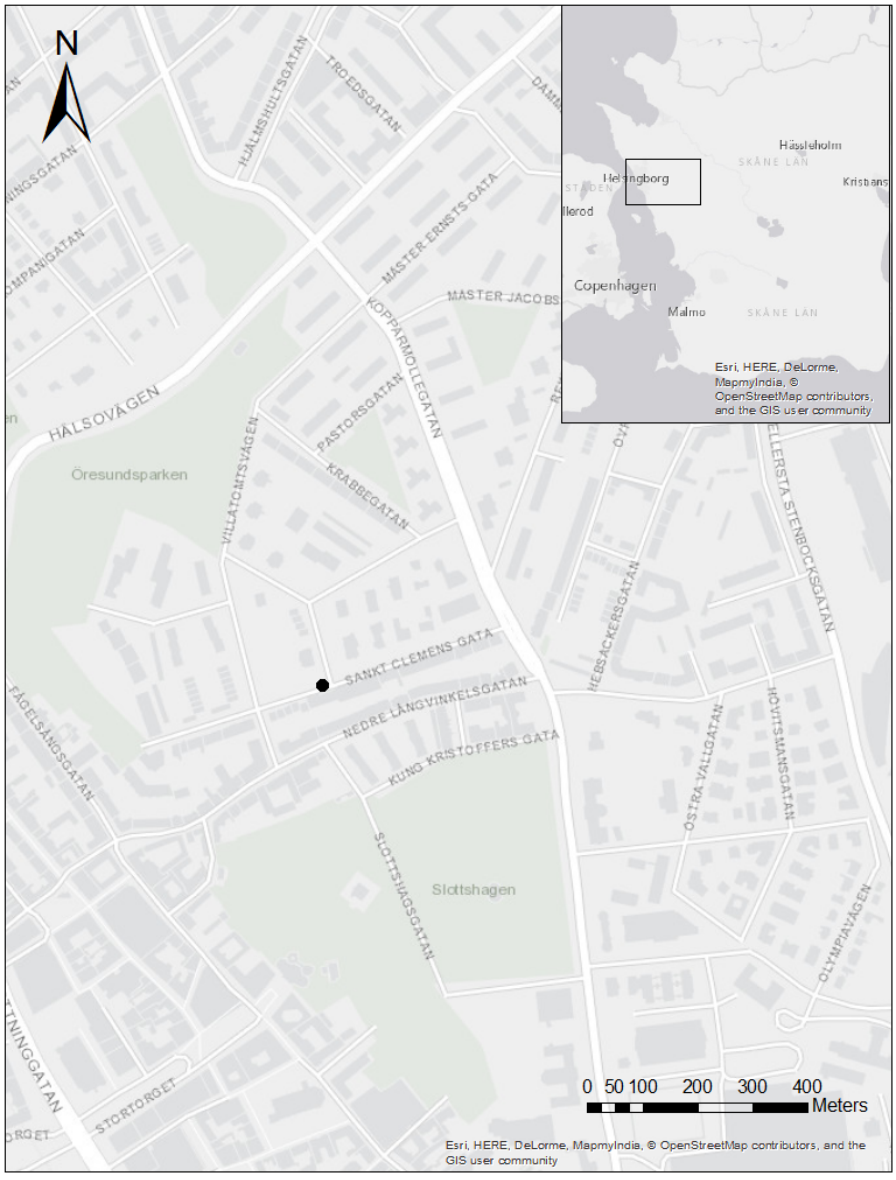

Figure 1 Map showing the location of the St Clement church in the modern Helsingborg. Created using ArcGIS 10.5 by Esri

The church of St Clement in Helsingborg is thought to have been built during the late 11th century (Anglert, 1996, p. 25) and was located within the medieval city walls, quite close to the medieval castle (fig1). Though the church had existed for more than 500 years, it was never mentioned in any medieval literature until 1537 when the roof was demolished. Mogen Madsen, who later became the bishop in Lund in 1589, describes how the St Clemens, St Petri and St Olai churches had been demolished after the Protestant Reformation in Denmark. These churches were never depicted in medieval imagery (Wiedhagen-Hallerdt, 2010:15).

The area of the church and cemetery was excavated several times, but a large excavation was performed during 1958-1962 with the goal of removing the church and graves. 441 graves were analyzed by Margareta Weidhagen-Hallerdt (2010) but the results was first published 50 years later in 2010 (Weidhagen-Hallerdt, 2010). New excavations were performed again during the 1980s, but this time of the most northern part of the medieval cemetery. A full osteological analysis was made on the skeletal remains from the 611 graves which were excavated and symptoms of leprosy were detected on five individuals (Anglert, 1996; Arcini, 1996b).

1.2 Aims and Research Questions

Leprosy is a stigmatized disease during the medieval times and individuals infected with leprosy were usually outcasts in the society. They were therefore often buried in the periphery of the cemetery, or sometimes even outside of the city walls. However, there are cases in Lund where individuals diagnosed with leprosy were buried at the cemetery, usually in the northern part or in the periphery (Arcini, 1999, pp. 118,121,113f, 130f). Since five individuals which showed symptoms of leprosy has been found in the northern part it is of interest to know if individuals with leprosy can be found in other parts of the cemetery as well (Arcini, 1996b, p. 9f). The placement of the graves and a general analysis of socioeconomic differences can also open for a discussion of the attitude towards leprosy in medieval Helsingborg since individuals with a higher social status were usually buried closer to the church. This thesis will therefore investigate the following questions:

- Is there evidence of leprosy in this material that was excavated in 1958-1962?
- Is there evidence of leprosy among individuals buried closer to the church as well as those who were buried in the periphery?

- Are there plausible socioeconomic differences between individuals that show evidence of leprosy and those who don't, which is reflected in stature, grave type and grave topography?

1.3 Research History

1.2.1 Previous Excavations

The St Clement church has been excavated several times throughout the last 130 years. The foundation of the church, as well as about 200 buried individuals, most of which had been buried in coffins made of sandstone, were found in 1884. An assembly of stones, which has been interpreted as possible rubble from the west tower, was also mentioned in the report. However, it was first a couple of years later, in 1890, that remnants of the church wall could be determined. Several more graves in stone coffins were noted next to and inside the church, though the amount of these are uncertain. Several graves and a large part of the northern wall were excavated during 1902-03. A couple of years later, in 1904-05, excavations of rows of coffins were performed. Most of the church walls were excavated by Torsten Mårtensson during a larger project in 1912-13. The results made it possible to create a reconstruction of the church, which was assumed to be a typical mid 12th century church. It was decided that these walls should be excavated but not removed. Fourteen graves in stone coffins were found next to the church foundation. Two of these were coffins with relief décor and both had been reused (Weidhagen-Hallerdt, 2010, p. 19ff).

Due to a large building project in the area of the medieval church, a larger excavation, lead by Margareta Weidhagen-Hallerdt, with the aim of removing the church walls and surrounding graves, was carried out. Since houses were built on the area above the southern part of the church, and the northern part was below a street, the whole church could not be uncovered at the same time. This problem was solved by dividing the excavation into two phases where the cemetery and most of the church walls were excavated during the first, more extensive, phase in 1958-62 and the southeast part of the church wall was excavated and removed in the autumn of 1962. It was also possible to investigate the boundaries of the cemetery during the first phase. Most of the church walls were removed during the excavation, though the north wall was preserved in the ground and is now marked in the street. New church walls that had not been excavated before were found during the first phase of the excavation which lead to new interpretations of the church and its constitution. It was now clear that there were two phases of the church, where the church had a western grave chapel, and probably a matroneum during the older phase. There was a larger fire during 1332, which can be

dated with coin findings. Due to the fire, the western part of the church had to be remodeled, the nave was extended to the west and a western tower was probably added. The remodeling of the church is the beginning of what the archaeologists include in the second, younger, phase. The dating of the church was reinterpreted and the church was now assumed to be almost 100 years older. Two graves, which were interpreted to be contemporary with the oldest phase of the church, contained coins that could be dated to the 1060s and probably before 1065. The coins indicated that the building of the church started during the 1060s and was completed sometime during the second part of the 11th century. About 20 graves were found under the church foundation. They had a deviant orientation to the stone church, which lead to an interpretation of an older predecessor to the stone church. An additionally 50 graves, most of which were situated north of the church, had the same orientation and were interpreted to belong to an older cemetery. This was somewhat confirmed by an area on both sides of the northern wall which did not contained any graves. The area was then interpreted to be the location of an older wooden church. A burnt layer was found below the stone church which was interpreted as a demolition of the wooden church, probably because of the decision to build the stone successor. The dating of the stone church is not certain but it is presumed to have been built during the early 11th century (Weidhagen-Hallerdt, 2010, pp. 21, 24f, 43).

A total of 441 graves were excavated and preserved during the 1958-62 excavation. Loose bone findings from presumably 800 individuals, mostly crania, were excavated and reburied. The graves were primarily dated by a typological analysis of the coffins. Five main types of graves were noted; wooden coffins, stone coffins, stone graves, ossuaries and earth graves. The first four types were divided into several subgroups based on the shape. However, no wood was preserved and the division of the wooden coffin types were based on color differences in the ground. The presence of nails was registered, though not used in the analysis. Weidhagen-Hallerdt (2010) noted that there were no stratigraphically difference and that all of the graves were more or less on the same level. She made the assumption that this would have led to damages on the older graves, especially in the area closest to the church. Arm positions were also noted during the excavation, which was used for dating, together with the coffin types. This was a relatively new method by the time of the excavation and was mainly used when the chronology of the different coffin types was created (Weidhagen-Hallerdt, 2010, pp. 44ff, 51, 91).

An additionally 611 graves were found during new excavations performed in 1986, 1987 and 1988 lead by Mats Anglert when the most northern part of the cemetery was excavated due to building of the area. All of these graves were determined to be contemporary with the stone church. It was clear during the preliminary excavation that the cemetery was more extended to the north than was assumed during the late 1950s excavation. Arm positions were registered during these excavations as well and though the positions were divided into the same four subgroups; it was registered with a larger

spectrum than during the late 1950s excavation. Arm positions could be registered on 86% of the individuals. Even though wooden coffin had been common, no wood was found due to the taphonomic conditions. Nails were found in 10% of the graves and wooden coffin types could be determined based on shape, although rarely. Stone coffins were occasionally found, although stone graves, with one or more stones around the head or body, were more common. However, it appears that most of the individuals has been buried without a coffin (Anglert, 1996, pp. 7, 15f).

The results from this excavation could not be compared to the one from the late 1950s since these results had not been published. However, based on the bad preservation of wood, Anglert (1996) criticizes the previous dating of the graves that was based on the wooden coffin types. This means that it could be somewhat problematic to date presumed wooden church. Nevertheless, the dating of the stone church based on architectural history and building technique aligns with the previous theories that the church was built during the late 11th century, more exact before 1070. It is also interpreted that the northern part of the cemetery was mainly used from the building of the stone church to the mid 14th century. It is plausible that the St Clement church lost some of it significance when the Church of Mary was built during this period. Although, the St Clement cemetery was occasionally used until it was demolished during the mid 1500s (Anglert, 1996, pp. 3, 13f, 25ff).

The osteological material from the late 1980s excavation was analyzed by osteologist Caroline Arcini (1996). Sex could be determined for 70.5% of the individuals; 49% were determined as male and 51% as female The material consisted mainly of adults and less than 30% of the individuals were younger than 20 years old. The average height among males were 172 cm, where the span was between 157-189 cm. Females tended to be shorter and the average height were 160 cm with a span between 146-174 cm. Height could only be estimated in 34% of the individuals. Since the osteological material couldn't be compared to that which were excavated during the late 1950s, it was not possible to discuss the age distribution further. Though, the results fit in quite well with the general result from contemporary cemeteries in Lund. Arcini (1996) mentions that the distribution of males and females was much more even than what had been seen in Lund and there were no sign of a division of males and females at the cemetery. A comparison between the osteological material from St Clement and St Petri was made which indicated that the individuals who were buried at the St Clement cemetery tended to be somewhat shorter (Arcini, 1996b, p. 2f).

Five cases of leprosy were found during the osteological analysis, all of which showed changes in the nose and the roof of the mouth. Three of the individuals were determined as male and two as female (Arcini, 1996: 7, 9f).

The total number of graves at the cemetery, including the most northern part, has been estimated to between 2500-3000 graves by Weidhagen-Hallerdt (2010). This number is based on the excavated graves in 1958-1962, the excavation during the late 1980s and graves which were noted in 1884 (Weidhagen-Hallerdt, 2010, p. 44f).

1.2.2 St Clement Church – a Scandinavian Perspective

The St Clement churches were quite common in the early medieval cities in Scandinavia, specially in Denmark. About 20 wooden churches dedicated to St Clement were built in Scandinavia during the 11th century. The oldest known church was built in Trondheim, Norway and it is possible that the cult of St Clement reached Scandinavia through connections to England (Cinthio, 1968; Crawford, 2008). There are other examples in cities such as Lund, Roskilde and London where the St Clement churches were built during the early stages of the cities. However, we can see that St Clement churches were mainly built in coastal cities and Lund is the exception. These cities, which have all been cities of importance, have later developed to market towns. This has led to two different theories; The churches were either built by the founders of the cities, or by foreign merchants. Although, since the St Clement churches were built during a such early stage in these cities it has been argued that the St Clement churches should be connected to the king in some way. Erik Cinthio (1968) uses the St Clement church in Helsingborg as an example of this. The fact that the church was build close to the castle could be a possible evidence of this (Cinthio, 1968; Weidhagen-Hallerdt, 2010, p. 19).

The St Clement saint died, according to the legend, in martyrdom by drowning in the sea with an anchor tied to his neck. This lead to believing that the saint would watch over seafarers, which is has been one of the theories of why these churches were built in coastal cities. This can especially be seen in medieval England. However, it is not known why this saint was popular in early medieval periods (Crawford, 2008).

Cinthio (1968) argues that this is an unlikely theory for the St Clement churches in Scandinavia that were built during the 11th century. He points out that it is impossible to know if the saint had the function of a saint for seafarers during the early medieval times and that it is more likely that the saint had a political significance or that the church was in possession of relics. The fact that the St Clement churches spread relatively fast during the 11th century could argue for that the St Clement saint was connected to power in some way (Cinthio, 1968; Weidhagen-Hallerdt, 2010, p. 19).

1.3 Leprosy

Leprosy is caused by the bacterium *Mycobacterium leprae* and is a chronic infectious disease. It was previously commonly known as Hansen's disease after Armauer Hansen who discovered the bacterium in 1873. The oldest case of leprosy in Sweden is from Halland and were dated to 0-400 AD. Though leprosy is present in the early cities, the disease is thought to have mainly affected the countryside (Trautman, 1984, p. 689f; Arcini, 1996b, p. 130). Leprosy can be cured today with antibiotic, which has led to a better control of the disease. Cases of leprosy has decreased drastically with 86% since the 1980s, but it remains to be a health problem in 24 countries in Asia, Africa and South America (McDougall, 2002, p. 17f; Roberts and Manchester, 2005, p. 193). WHO has currently set a goal, which focuses on human rights, to further reduce the presence of leprosy worldwide, but also to remove the stigmatization that surround it by 2020 (World Health Organization, 2016).

The earliest description of leprosy is, from China and India in 600 BC. One of the earliest skeletal evidence is, however, from Egypt and was dated to 500 AD (Møller-Christensen, 1978). It is known that leprosy occurred in the Mediterranean after Alexander the Greats' travels to India in 327-325 BC and it is possible that that is how the disease reached the Mediterranean area (Arcini, 1999, p. 130). The earlies finding in Sweden is a woman from Halland, in southwest Sweden, which is dated to 0-400 AD (Arcini and Artelius, 1993). One of the earliest studies of leprosy in archaeological remains was performed by Carl M. Fürst (1926). He found signs of leprosy in the skeletal remains of bishop Sunesson, who lived during the late 12th and early 13th century (Rydbeck, 1926).

The severity of the physical symptoms can vary between patients. However, this is not due to a variation of the leprosy bacterium but rather the status of the individuals immune system (Arcini and Artelius, 1993). Other factors such as malnutrition, genetics, or co-infections can also affect the severity of leprosy that each patient experience (Krause-Kyora *et al.*, 2018). The visible signs of leprosy, such as nodes on the face, loss of eyebrows, and a sunken nose makes it hard for an infected person to hide the disease. Another effect of the disease is loss of sensation due to damage of the peripheral nerves in the upper and lower limbs. This leads to the patient developing severe damages to the tissues which often results in secondary infections and ulceration. The patient can also experience paralysis of these muscle groups which leads to deformity of the hands and feet, such as claw-hands and dropfoot. More advanced leprosy can cause loss of phalanges as a result of retraction of the skin. There are also cases where the patient is retaining the nails event though only the metacarpals are

remaining (Arcini, 1999, p. 130; Roberts and Manchester, 2005, p. 197; Roberts, 2011, p. 255f).

Skeletal changes in the feet tend to be more frequent than changes in the hands, both in modern but also archaeological cases. The reason could be as simple as the fact that one sees the hands more often, thus soft tissue damages are detected early, which makes hands less likely to develop skeletal changes. Severe cases of damages to the feet, which are common in leprosy, leads to collapsing of the arch of the foot. Bone changes of the tibia and fibula can be seen as well. This is often either a result of the infection of the foot spreading upwards or other traumas (Roberts and Manchester, 2005, p. 195f).

Leprosy can be classified into two different types: Lepromatous and tuberculoid leprosy, which are the two extremes. There are also intermediate forms in between these. Lepromatous leprosy is a highly effective version which affects the soft tissue organs, multiple limbs and the face. Damage of the bone, especially in the mouth and nose, can also be seen in patients of lepromatous leprosy. This is also the most identified version of leprosy in archaeological materials. Tuberculoid leprosy is considered to be less effective and causes less severe damage to the soft tissues. Limbs are affected, though usually one or two rather than multiple. These changes tend to be symmetrical in lepromatous leprosy. However, this is not the case in tuberculoid leprosy. The damages in the nose and mouth areas are not seen in tuberculoid leprosy and there is less severe bone damage overall. For this reason, tuberculoid leprosy is not commonly found in archaeological material (Arcini, 1999, p. 113; Roberts and Manchester, 2005, p. 195).

Leprosy is often contracted during the childhood and the disease has a relatively long incubation period, sometimes up to 40 years (Arcini, 1999, p. 113). Although, it can also be as short as 2-5 years and there are cases were symptoms has developed in young individuals. The disease is also more common among males than females (Roberts and Manchester, 2005, p. 194). Although animals can be carriers of leprosy, it is most likely that infected persons are those who spread it. It is more likely that it is spread through untreated persons who are infected with the lepromatous form of leprosy. The bacteria spreads by the transmission of droplets, most likely from the nose, and it has a capacity to survive outside the body for several days. It is suggested that the bacteria have a tendency to spread within families since it often needs repeated incidents of exposure. This tendency has also caused a debate concerning the possibility that leprosy could be caused by genetic factors. This has, however, been disproved. Although, it is possible to argue that lepers found at medieval cemeteries could be related. It is also certain that leprosy cannot be transmitted venereally, which was believed during the middle ages (Fine, 1988, p. 365f; Arcini, 1999, pp. 113, 131; Roberts and Manchester, 2005, p. 194).

Even though leprosy is a chronic disease, the cause of death is not due to leprosy itself but due to sequelae. The infections caused by leprosy can generate other diseases, such as sepsis or tuberculosis, where the latter is the most common cause of death today among individuals who is suffering from leprosy. There are many similarities between the *Mycobacterium leprae* and *Mycobacterium tuberculosis*. Recent studies have shown that individuals who show immunity to tuberculosis are, in some extent, immune to leprosy as well. The BCG vaccine, which prevents tuberculosis, can also provide a 20-80% protection against leprosy. Though, since tuberculosis does not require as much exposure as leprosy, it is more easily spread and is therefore a larger problem than leprosy (Ortner, 2002, p. 75; Roberts and Manchester, 2005, p. 204).

Studies of ancient DNA have shown that there is a possible link between some of the strains of the leprosy bacterium that was found in European samples, dated to the medieval period, and the Middle East. Other samples showed that there was a resemblance strains that had its' origins in the United States. The latter strain, which was found in Odense, Denmark, show a close resemblance to a modern strain of the leprosy bacterium. This indicates that the decline of leprosy during the 16th century was not caused by the bacterium losing virulence, but rather competition between leprosy and other diseases, such as tuberculosis. Another factor could be general changes in the hosts' immune system, or improved living conditions (Schuenemann *et al.*, 2013). More recent studies have found 10 more different strains of leprosy from medieval Northwestern Europe. The study suggests that there was a higher diversity of leprosy in the medieval Europe than what was previously known (Schuenemann *et al.*, 2018). It has also been discussed that tuberculoid leprosy became more frequent than the more aggressive and infectious lepromatous leprosy. It is also possible that tuberculosis came to dominate over leprosy (Arcini, 1999, p. 131f).

Inskip et al (2017) performed a study of a female from Hoxne, Suffolk where skeletal changes in the rhinomaxillary area was discovered, which are typically seen as a symptom of leprosy. The aim of the study was to confirm the disease since the post cranial skeleton was not preserved. It was therefore not possible to investigate however the skeletal changes was due to a leprosy infection, which could possibly show symptoms on other bones, or if they were caused by another disease. The results from the aDNA studies showed positive results for the leprosy bacterium, which means that the skeletal changes were caused by leprosy. The strain of leprosy, which was found in the sample from the female, has also been found at other British sites, but also in Denmark and Sweden. It was also possible to date the female to 885-1015 AD with radiocarbon dating during the same study. A similar strain, found in an individual from the Great Chesterford, which is the oldest case of leprosy in both Britain and Europe, dated 415-545 AD. This shows that similar strains of leprosy could persist for hundreds of years in Britain (Inskip *et al.*, 2017).

A similar DNA study on a skeletal material from the St Jørgen leprosarium in Odense, medieval Denmark was recently published. 69 individuals were included in the study and all of them showed skeletal changes in the rhinomaxillary area. The samples from all of the individuals, which were used in this study, showed positive results for the leprosy bacterium. When combining the results from this study with previous ones, they could see that at least eleven different genomes at the St Jørgen leprosarium alone. This study also revealed that leprosy probably originated in southeast Europe or in western Asia (Krause-Kyora *et al.*, 2018).

Individuals afflicted with leprosy have, both in history but also during present times, been treated inhumanely. This can be an effect of lack of knowledge of how the disease spread, but also how it has been depicted in literature and media throughout history. The fear of leprosy during the medieval times was probably based on biblical references and descriptions of the disease. There are also descriptions of how lepers were forced to wear a bell, which signalized for the non-infected persons to avoid contagion. This is reflected in the common description of lepers who were *dead to the world but alive unto God* (Arcini, 1999, pp. 113, 130f; Roberts and Manchester, 2005, p. 193f).

It is also common for patients to develop psychiatric and neurotic symptoms and these problems tend to be more common among individuals who have developed physical deformities, which have probably affected the social stigma further. The voice can also be affected in the larynx is infected. It becomes hoarse and coarse, which is one of the characteristics of leprosy patients. However, the voice is only affected in more advanced cases. Roberts and Manchester (2005) remarks that the deformities themselves probably provoked fear among the medieval society. The fact that leprosy hospitals was built outside of the city is also one of the clearest signs of the social stigma. This has, however, been criticized as the leprosy hospital could have been shelters for those who were infected with leprosy (Arcini, 1999, p. 130; Roffey, 2012, p. 221). It has also been argued by Brenner (2007) that lepers were a part of the medieval society in Rouen during the 12th and 13th century (Brenner, 2007). Although, the fact that lepers were buried in the periphery of the cemeteries is not necessarily a sign of stigmatization. It has been suggested that leprosy was more common among the poor, which had more cramp living conditions and therefore a higher risk of being infected. The burials in the periphery suggest that the lepers were of a lower social status. However, if this was because of the disease itself or if the individuals belonged to a lower class when they became infected could be discussed further (Møller-Christensen, 1978; Arcini, 1999, p. 131; Roberts and Manchester, 2005, pp. 195, 197f).

More lepers have been found at the medieval cemeteries in Lund than in any other city in the Nordic countries. Arcini (1999) suggests that this could be because of the fact that they were buried before the first hospital in Lund was built, which occurred between 1140 and 1150. This is somewhat confirmed since she found no signs of individuals

with leprosy found on cemeteries dated to after 1100. Though, when the 19 skeletons from the hospital was analyzed after the excavation by Blomqvist (1949), no signs of leprosy were found. However, about 70% of the individuals from the Næstved hospital in Denmark showed skeletal changes indicating leprosy. This difference could possibly be explained by the fact that the skeletal material from the hospital in Lund were poorly preserved. Fjälkinge and Sigtuna shows similar patterns for burying of lepers as Lund where they often were buried in the outer area of the cemetery. (Arcini, 1996a, 1999, p. 130f).

1.4 Theoretical Perspectives

1.4.1 Bioculture and Bioarchaeology

Traditionally, archaeology focuses on objects as a material culture to interpret and understand the ancient human behavior. Incorporating the human body, as a skeleton, into the material culture gains further understanding of health, diseases, physical behavior, or even migration patterns. With bioarchaeology, or historical osteology, we can study the actual humans themselves, and not only their belongings in a cultural context, to gain further understanding of the ancient societies (Larsen, 1997, p. 1ff).

Bioculturally oriented bioarchaeology focus on the relationship between humans and the social, cultural and physical environment, thus culture and biology is directly connected. The effect of cultural, historical, and political-economic impact, such as distribution of resources, on the human biology started to be investigated during the 1980s and 1990s. This approach shows how we can detect social relation, which is reflected in the osteological material (Goodman, 1998, p. 19f; Zuckerman and Armelagos, 2011, p. 20).

The human biology can appear to be invisible in the archaeological material. However, it is impossible for humans to mask the biological consequences of malnutrition or disease. It is even possible that the experience of these sufferings can even be altered in the archaeological material. Zuckerman and Armelagos (2011) highlights how a biocultural approach can reveal the biological consequences of the human action through distribution of disease, malnutrition, trauma, and biological adaptation (Zuckerman and Armelagos, 2011, p. 21f).

1.4.2 The Osteological Paradox

An osteological material can only reflect the individuals who did not survive and is therefore not a direct image of the living society. This has been discussed and presented

as the *osteological paradox* by Wood et al (1992). It is impossible to know the collective risk of death since we never have samples of all living individuals of a certain age group. If an individual survived a disease but died at an older age, the individual could never represent the age where he or she encountered the disease. This problem, called *selective mortality*, illustrates the fact that there is a high risk of overestimation of the true prevalence of a disease if we see a high frequency of it. This cannot be solved by obtaining larger materials, but is rather a problem which is built into the structure of the data. It is also important to highlight the risk of *hidden heterogeneity,* which means that the ancient society was made up of a variation of individuals of different susceptibility to disease or even death. Age-specific interpretations of mortality can therefore not be estimated, since frailty can differ based on for example socioeconomic differences or trends in health. During an analysis *demographic nonstationarity* needs to be taken into consideration. This means that a population is affected by migration, morbidity and fertility. A nonstationary population is more sensitive to changes in fertility rather than changes in morbidity. This means that the age at death is an indicator of fertility rather than morbidity since a population is never completely stable (Wood *et al.*, 1992, p. 344f).

The osteological paradox reflects the impossibility to distinguish if a social group was at largely affected by a deadly disease but died before visible changes on the skeleton could develop, or if they were never in contact with the disease at all. An individual who were infected with the disease but survived long enough for the disease to affect the bone would therefore appear to have been more affected by it than an individual who died during an early stage of the disease. This is important to take into consideration when discussing the affect that leprosy had in the medieval society. It is possible that an individual, who shows symptoms that appear to be less severe, have experienced a rapid development of the disease. An individual can therefore easily be dismissed as less affected by the disease because of lack of symptoms on the bone material, which would be erroneous assessment (Wood *et al.*, 1992, p. 345).

2. Material and Methods

This study is based on the osteological material from the 1958-1962 excavation, which is currently curated by Kulturmagasinet in Helsingborg. Weidhagen-Hallerdts study included the 441 individuals from the excavation and 19 individuals from the 1913 excavation (Weidhagen-Hallerdt, 2010, p. 46). However, only 417 individuals were available for analysis and the individuals from the older excavation were not included.

Weidhagen-Hallerdt (2010) determined sex and age on the individuals (Weidhagen-Hallerdt, 2010, p. 104). Although, new methods have been developed since the time of her study and an updated study was necessary. The difference in results are marked in the database, which is available in appendix I.

The fragmentation level of the material varies a lot. Both skeletons which are almost complete and nearly not damaged, as well as skeletons which are highly fragmented can be seen in the material.

2.1 Dating

This method is based on the prerequisite that the arms were intentional positioned by someone during the entombment. It has been showed that trends in arm positions tends to correlate with datable artifacts during the early medieval period, which is why it had been commonly used as a dating method for graves. The arm positions are divided into nine groups based on how the forearms are placed in relation to the body, given that the upper arms are parallel to the body (Redin, 1976, p. 30ff). However, it has been pointed out that the usage of arm position is not a reliable method for dating cemeteries which were used during both the early and late medieval periods, since positions that was used during the earlier periods were used again after the reformation 1532 in Denmark (Boldsen and Mollerup, 2006, p. 346).

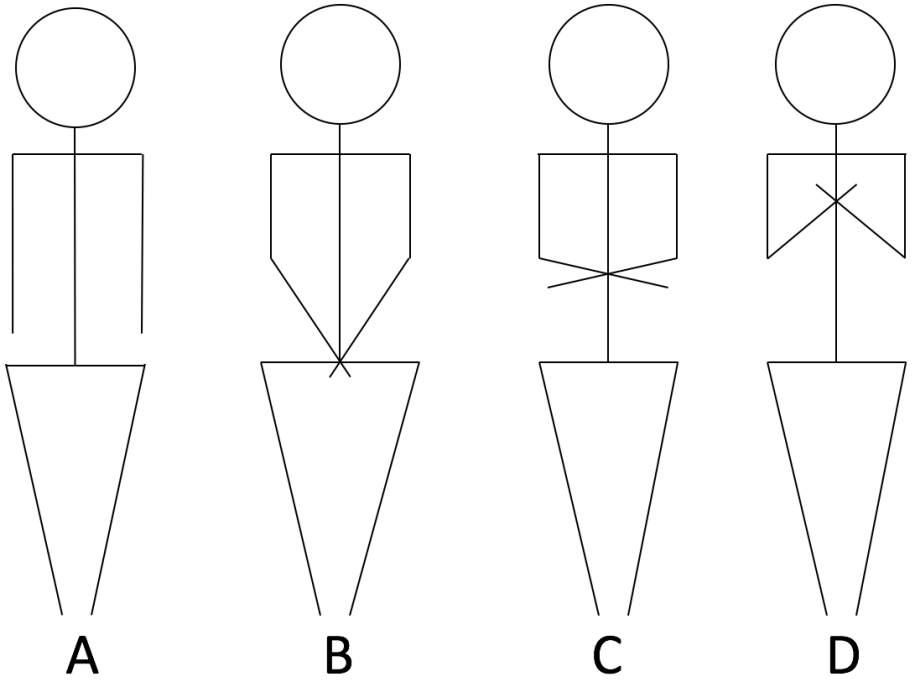

Figure 2 An illustration of the four main groups for arm positions (A-D) based on the method developed by Redin (1976).

Arm positions were registered in the 1958-62 excavation, but since it was a relatively new method for dating it mainly used as a tool for creating the coffin chronology. A simpler version was used at the 1958-1962 excavation of St Clemens cemetery, where the arm positions were divided into four main groups (A-D). The arms are parallel to the body in type A position, which is the positions that was commonly used during the 11th and 12th century. The transition to type B position was during the 13th century where the hands were crossed above the pelvis. The next transition, to type C, was during the 14th century and the forearms were crossed above the stomach. The last transition from type C to type D was during the 15th century and this type dominated the 16th century. The hands were crossed above the chest. There are variations within these groups and there are cases where one arm could be in another position than the other arm, but these are the four general main groups (fig 2) (Redin, 1976, p. 33; Weidhagen-Hallerdt, 2010, p. 91).

The arm positions were registered for each arm separately during the 1958-1962 excavation, but were never used when discussing the dating of the graves (Weidhagen-Hallerdt, 2010, p. 91). This method was used during the 1980s excavations as well, however as a more advanced version of Redin's (1976) model with 29 groups (Anglert, 1996, p. 15). Since arm positions were used during the late 1980s excavations as well, it

can more or less be used as a tool for dating in this study to gain a general chronology of the cemetery.

The dating of the graves from the 1958-1962 excavation was primarily based on the different types of coffins. These were divided into four main groups (A-D) which were divided into subgroups. The chronology for wooden coffins were based on the shape of the colorings in the ground since no wood were preserved (Weidhagen-Hallerdt, 2010, pp. 46ff, 51). Due to the preservation issues, Anglert (1996) argues that the chronology cannot be as certain as Weidhagen-Hallerdt (2010) presents (Anglert, 1996, p. 13). The chronology of the coffins will not be used in this study, however the chronology is described further in Weidhagen-Hallerdts book (Weidhagen-Hallerdt, 2010, pp. 46–104).

2.1.1 Taphonomy

Though the arms were deliberately positioned during the burial, it is important to acknowledge that the body is affected by the decomposition process. If the body is buried in an open space, for example in a coffin or a sarcophagus, the bones can naturally disarticulate and slip. These movements, which are caused by gravity, depend on the original position of the bones, for example if the body is placed on the back or on the side. However, if the body is buried in a filled space, or without a coffin, it is more likely that these displacements does not occur. (Duday, 2006, p. 40f).

The movement of the bones results in that the position that the body is found in during an excavation is not the necessarily position that it was originally placed in. If the body remains more or less in the same position it is likely that the in-filling of the grave was progressive and the sediments replaced the soft tissues as it decomposed (Duday, 2006, p. 41).

The movement of the bones is an important factor when discussing arm position as a dating tool. Though only the four main types of arm positions (A-D) were registered during the 1958-1962 excavation, it is likely that variations within these types occurred, but were overlooked. This could mean that arms that were originally placed with the hand above the pelvis could have slipped during the decomposition process and were found in a position that have been interpreted to be parallel to the body during the excavation. It is possible that this bias could have been affected if subtypes of the arm positions were registered as well, as during the 1980s excavation (Redin, 1976; Anglert, 1996, p. 15). However, it is to be remembered that registering arm position were a relatively new method during the 1958-1962 excavation and that the methods for registering arm positions and using these as a dating tool has changes during the past 50 years.

2.2 Ageing

Individuals were only determined to adult or juvenile since a more specific assessment was not necessary for this analysis. Due to the time limitation of the project I decided to include as many individuals as possible in the material rather than determine a more specific age on the individuals.

Since no further dividing of age groups have been done, everyone with unfused joints in the long bones have been determined as juvenile (Scheuer and Black, 2000; Cardoso, 2008) and no division between children and teenagers were made. The youngest individual among the adults could therefore be in the age range of 14-20 years old (Scheuer and Black, 2000).

Teeth and jaws has been preserved to a large extent and development of the permanent teeth has also been used as an indication of age (Ubelaker, 1978).

2.3 Sexing

Since the pelvis provides with the most accurate indication of sex, this has been used as a main indication of sex. The pubic bone has primarily been used. This bone, however, has not always been present due to taphonomic loss. In these cases, other indicators, such as the grater sciatic notch and morphological features on the skull, have been used (Buikstra and Ubelaker, 1994).

The pelvis is generally fused during the age of 14-17 years old and it would be possible to determine sex even though the long bones would not be completely fused. However, since individuals in the age range has been included in the juvenile age group, sex has not been determined on these individuals.

During the statistical analysis, individuals determined as probable males or females (M? and K?) has been included in the male and female statistical group.

2.4 Estimation of Stature

Stature and the physical status during growth is closely connected. Though stature is mainly dependent on genetic factors, by 80%, it is still affected by surrounding environmental factors with 20%. Malnutrition and diseases during childhood can cause the bones to not be able to reach the full growth potential, thus resulting in a shorter

stature (Steckel, 2012; Stinson, 2012, p. 593f). This would mean that a variation of stature in a population could reflect a variation of wealth and social status as well as nutritional status (Tornberg, 2018, p. 62). The general stature in a population can also be affected by migration, where exogamy tend to increase the general stature (Stinson, 2012, p. 601). However, migrators who are unfamiliar with the microbial flora can lead to the opposite effect (Steckel, 2012). Stature, as well as other anthropometric values such as weight, is used as an indication of physical status today (World Health Organization, 1995), but it can also be used when analyzing archaeological human remains.

The estimation of stature in this study is based on the maximal length of the femur. Measurements were only taken if the epiphyses were completely fused and measurements were taken on intact bones. The left femur was primarily used to get a cohesive result as possible. If the left femur was missing or to fragmented, the right femur was used instead. The stature was calculated by the method of Sjøvold (1990). Since it is based on an organic correlation from different populations it is generally neutralizing ethnicity. The method is also known to not under-estimate tall individuals or over-estimate short individuals (Sjøvold, 1990; Tornberg, 2018, p. 60). It was therefore considered to be a preferred method for this material, rather than the method of Trotter and Gleser (1952). This is also the method which was used during the analysis by Arcini (1996). This will help gaining a more cohesive result when comparing the two analyses (Arcini, 1996b, p. 2). When discussing stature, the calculated stature is referred to. Raw measurements are available in appendix I.

A Mann-Whitney u-test test was applied to investigate however there was statistically significant differences in stature between the different grave types. The stature can be interpreted to be generally shorter if the majority of the individuals, which stature could be estimated from, were found in earth graves (Sen, 1963). The test, which is a non-parametric test, is used to test the null-hypothesis and was done in R (R Core Team, 2016).

2.5 Identifying Leprosy

Since it is common that changes of the rhinomaxillary area develop early in leprosy, this symptom has therefore been used as primarily indication of leprosy in this study. The criteria, which were developed by Møller-Christensen (1978), have been used as a main identification and diagnosis method. This is currently the most commonly used method for identifying leprosy in osteological material (Ortner, 2002, p. 73; Rubini, Zaio and Roberts, 2014; Inskip *et al.*, 2017; Krause-Kyora *et al.*, 2018). The rhinomaxillary syndrome is also an indication of lepromatous leprosy, which is the most aggressive but

also contagious version of leprosy (Arcini, 1999, p. 113). Hands and feet have also been examined for skeletal changes that can be connected to leprosy.

Osteological identification of leprosy is often based on the damages that is caused by infection of the soft tissue surround the nose and mouth. Pitting of the bone in the palate and perforation, which is caused by inflammation, is commonly found. Resorption of the alveolar bone surrounding the incisor teeth can also appear which can, in more severe cases, lead to the loss of these. These changes were first documented by Vilhelm Christensen-Møller (1978) who called them *facies leprosa* (Møller-Christensen, 1978; Ortner, 2002; Roberts and Manchester, 2005, pp. 195, 198). However, the changes have also been called *rhinomaxillary syndrome* (Andersen and Manchester, 2005). These changes develop during the earlier stages of leprosy which makes it a reliable indication of leprosy in osteological materials (Ortner, 2002, p. 74; Rubini, Zaio and Roberts, 2014, p. 17).

It has been suggested that the rhinomaxillary syndrome itself is necessarily not an evidence of leprosy (Inskip *et al.*, 2017). Cook (2002) presents cases from the pre-Columbian New World which indicates that syphilis easily can be mistaken for leprosy. Other infections in the mouth and nasal regions such as paradontitis, but also developmental lesions or trauma, can possibly mimic the rhinomaxillary syndrome. This has been seen in studies has been based on materials where leprosy were not present (Cook, 2002). There are, however, recent studies of aDNA where the leprosy bacterium has been found in individuals which had developed these skeletal changes in the rhinomaxillary area (Inskip *et al.*, 2017; Krause-Kyora *et al.*, 2018).

2.7 Source Criticism

A general problem for this analysis is that there is a lack of information from the 1958-1962 excavation. No stratigraphy was documented during that excavation, which makes it hard to relate the different graves to each other. This problem is also caused by the plan drawings which does not include all graves. Though digging units are referred to in Weidhagen-Hallerdts (2010) database, these are not found on the plan drawings. A large amount of years, nearly 50 years, passed between the excavation and the finished book which could have affected the interpretation.

The excavation technique for finding small bones might have been inadequate, possibly because of persons who performed the excavation were not trained in excavating human remains. Though, it is to be remembered that the archaeological excavation techniques have developed during the last 50 years. However, this could explain the general lack of phalanges in the material.

23 graves which were included in Weidhagen-Hallerdts (2010) study was not available for analysis within this thesis work. Though it is only 5% of the total material it could possibly have affected the results, especially in the analysis of leprosy.

Fragmented bones in the skull were often glued together which made it problematic to investigate the symptoms of leprosy in a few cases. The skulls had also been separated from the rest of the remains since the 1960s and sent to Stockholm for an analysis by a dentist.

3. Results

3.1 Age and Sex

It was possible to determine age for a high amount (98,6 %) of the individuals due to the wide categories for age, where individuals were only determined as adult or juvenile. There is a high presence of adults (80%) and 18,5% were determined as juvenile (fig 3).

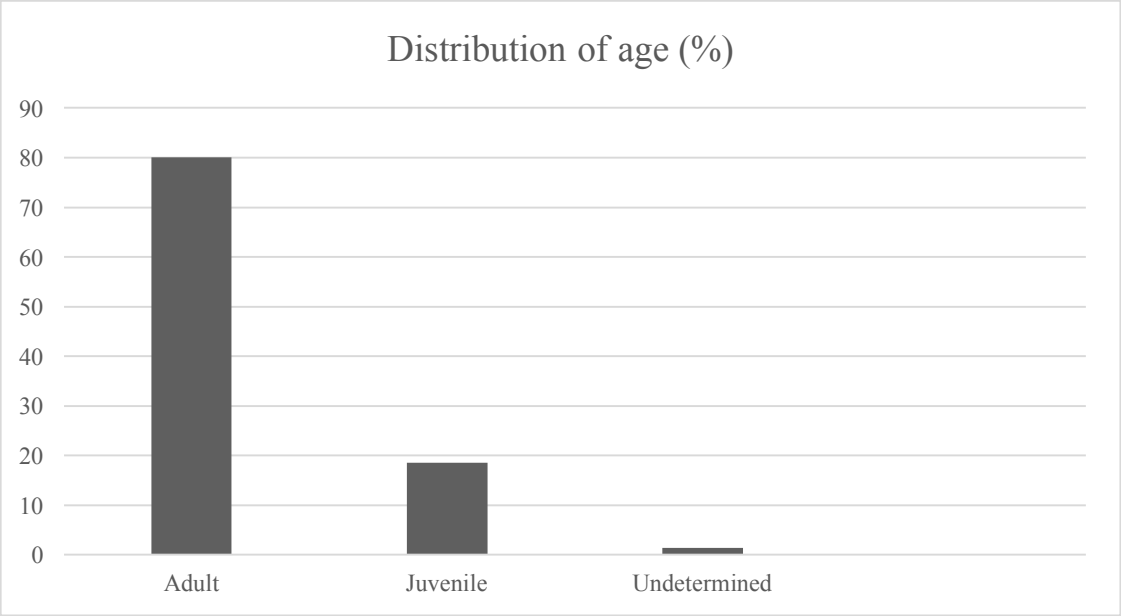

Figure 3 The distribution of age presented in present. The diagram is based on all of the examined individuals (n=417)

Due to the fragmentation rate it was possible to determine sex on only 187 of the 335 adult individuals (55,8%). There is a higher number of females (n=100), than males (n=74). The result is presented in the diagram below (fig 4).

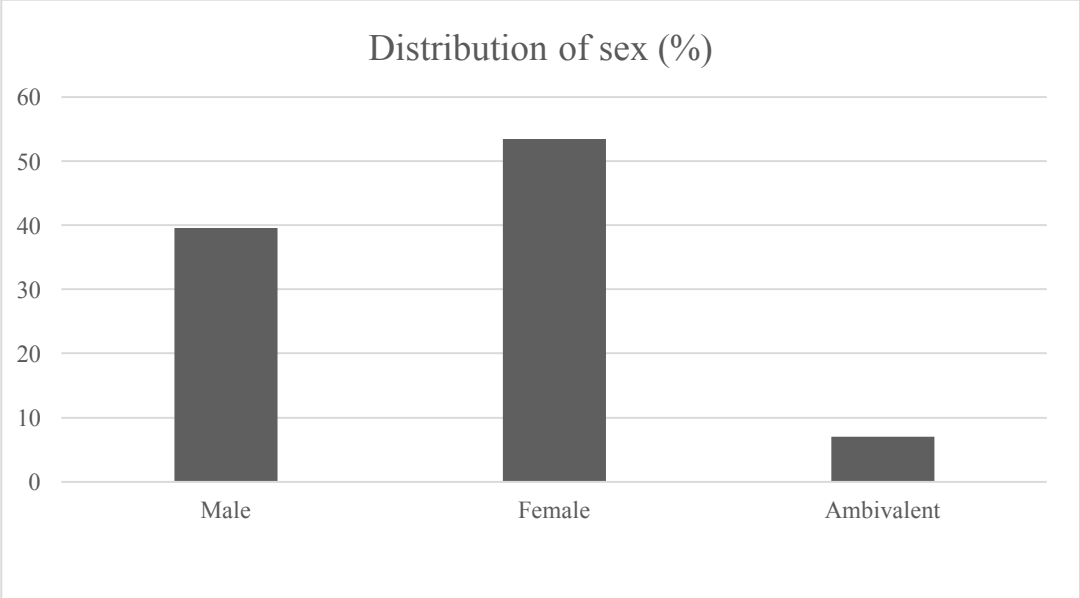

Figure 4 The distribution of sex among the adult individuals where sex could be determined (n=187).

3.2 Stature

Stature could be estimated for 41 males where the shortest was 152 cm and the tallest was 184 cm. The average height among males was 167 (fig 5). The average height among females (n=41) was 160 cm, where the shortest was 147 cm and the tallest was 174 cm (fig 6). Raw measurements are available in appendix I. The distribution of stature is presented below in figure four and six. Most of the male individuals can be found in the span of 165-169 cm and most female individuals are found in the span of 155-159 cm. The span between the tallest and shorter males are broader than what is seen in females. However, this is a common difference (Stinson, 2012).

The MWU-test was applied using individuals that were buried in earth graves and in stone coffins. Two separate tests were done for males and females. The test for females showed a p-value of 0.2403, which is not of statistical significance. The test for males showed a p-value of 0.0689, which is much lower, however not of statistical significance either. The MWU-test thus show that stature does not differ in any significant ways between individuals inhumed in burials that are regarded as of lower status and those considered as high status burials.

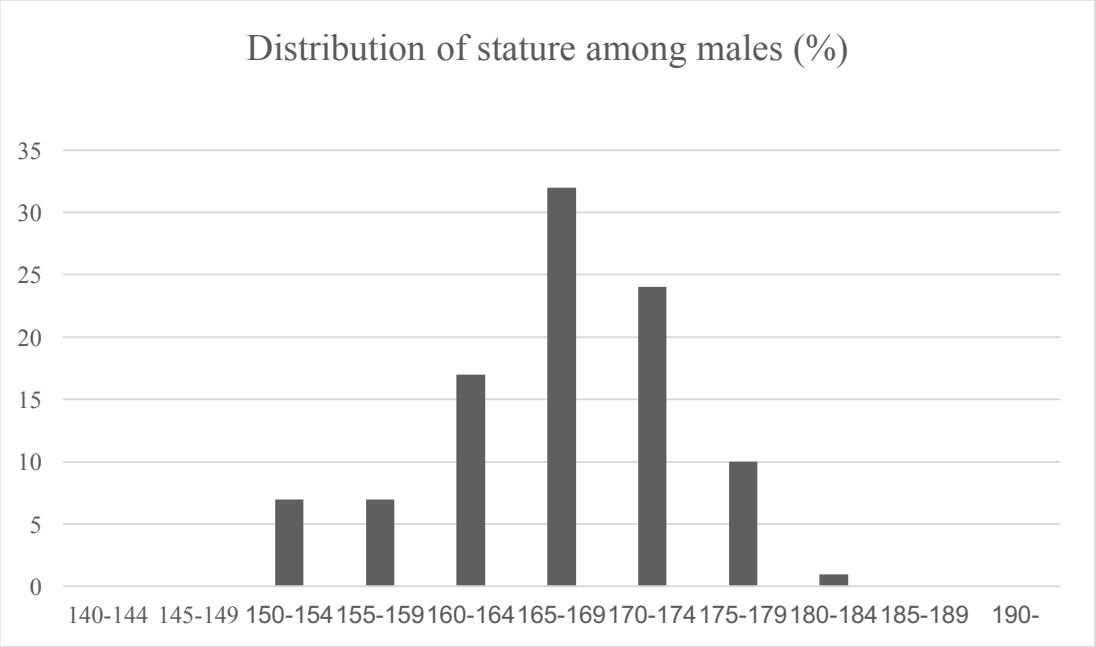

Figure 5 The distribution of stature among males (n=41)

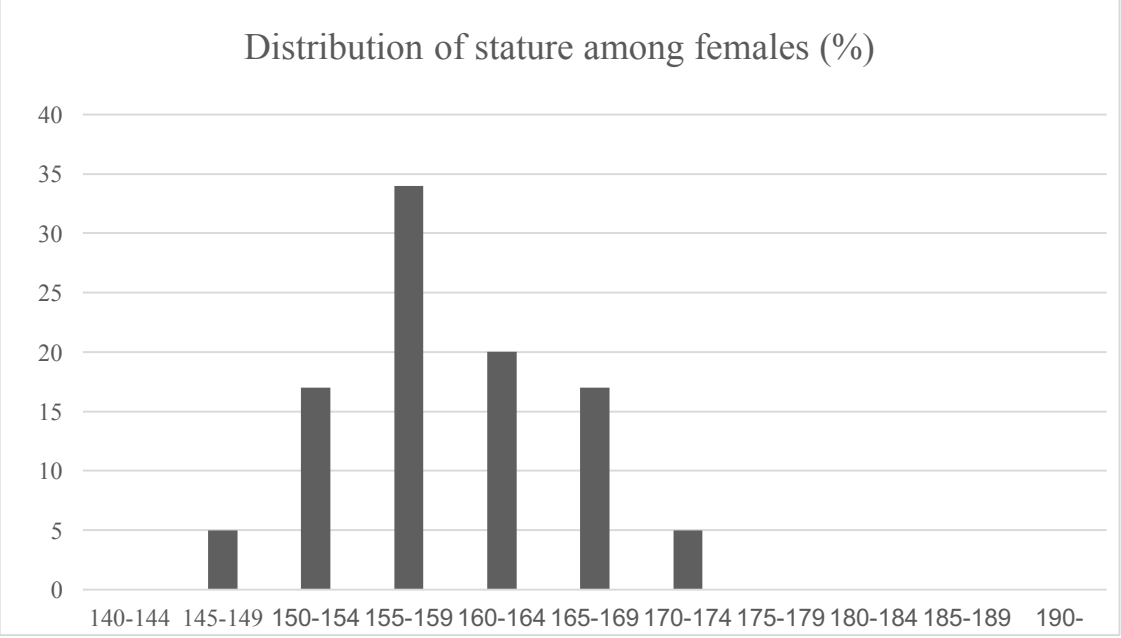

Figure 6 The distribution of stature among females (n=41).

3.3 Leprosy

Leprosy was detected in two individuals, one male and one female. The frequency of leprosy is 0.5% in this material and both individuals showed changes in the rhinomaxillary area. The two cases of leprosy will be presented individually.

3.3.1 Grave Number 40

This individual was determined as probably male (M?) and was estimated to be 164.5 cm tall. He was buried without a coffin (C) and his arms was positioned with his both hands crossed above the pelvis (B/b). The arm positions suggest that he possibly lived during the 13th century and the grave is thought to have been associated with the cemetery that belonged to the stone church. This individual was buried south of the stone church, relatively close to what seems to be the southwestern border of the cemetery. The grave is oriented with the head in the south and feet in the north. The skeleton was relatively well preserved, although the phalanges for both hand and feet were missing and there were no changes on the metacarpals of metatarsals.

Figure 7 The skeletal changes in the nose, caused by leprosy, which were found on the individual in grave 40. Superior view

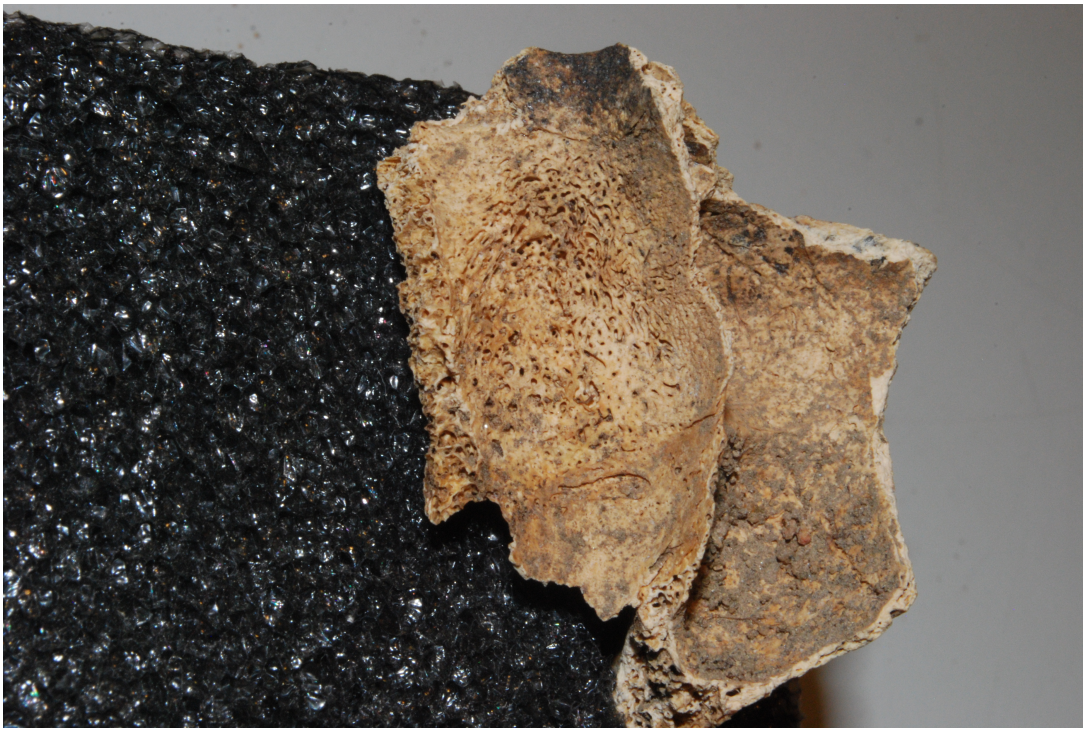

Figure 8 The skeletal changes, caused by leprosy, in the right side of the nose, which were found on the individual in grave 40. Superior view.

Figure 9 Skeletal changes in the roof of the mouth, caused by leprosy, which were found on the individual in grave 40. Inferior view.

Figure 10 The skeletal changes that has affected the alveolar bone. Anterior view.

There are distinct changes in the rhinomaxillary area, where inflammatory changes were found in the nose (fig 7) and more severe changes were found in the right side than in the left (fig8). Pitting was found in roof of the mouth (fig 9), which is an indication of inflammation. The alveolar bone was also affected with possible atrophy (fig 10), however the maxilla had been affected by the taphonomic process as well. The infection had also affected the nasal spine. The bone inflammatory changes in the nose is quite coarse, which could indicate that the inflammation was active at the time of death. Both the right and left tibia showed skeletal changes on the anterior side which were caused by periostitis.

3.3.2 Grave Number 334

This individual was relatively well preserved, although some parts of the skeleton were missing, such as the hands and feet. The individual was determined as a female (K) but stature could not be estimated. Only one arm was documented during the excavation and this was placed parallel with the body (?/a), which indicates that the grave could be dated to either the 11^{th}-12^{th} century where arm position type A dominated, or during the transition between arm position type A to B during the 13^{th} century. However, this grave is also thought to have been buried at the stone churches cemetery and was found closer to the stone church, on the north side. The grave had the same orientation as the

stone church. She was buried in a stone grave with a flat cut sandstone close to the head (C4a) and there is a possibility that the grave could have had a lid.

Figure 11 Skeletal changes in the nose, caused by leprosy, which were found on the individual in grave 334. Superior view.

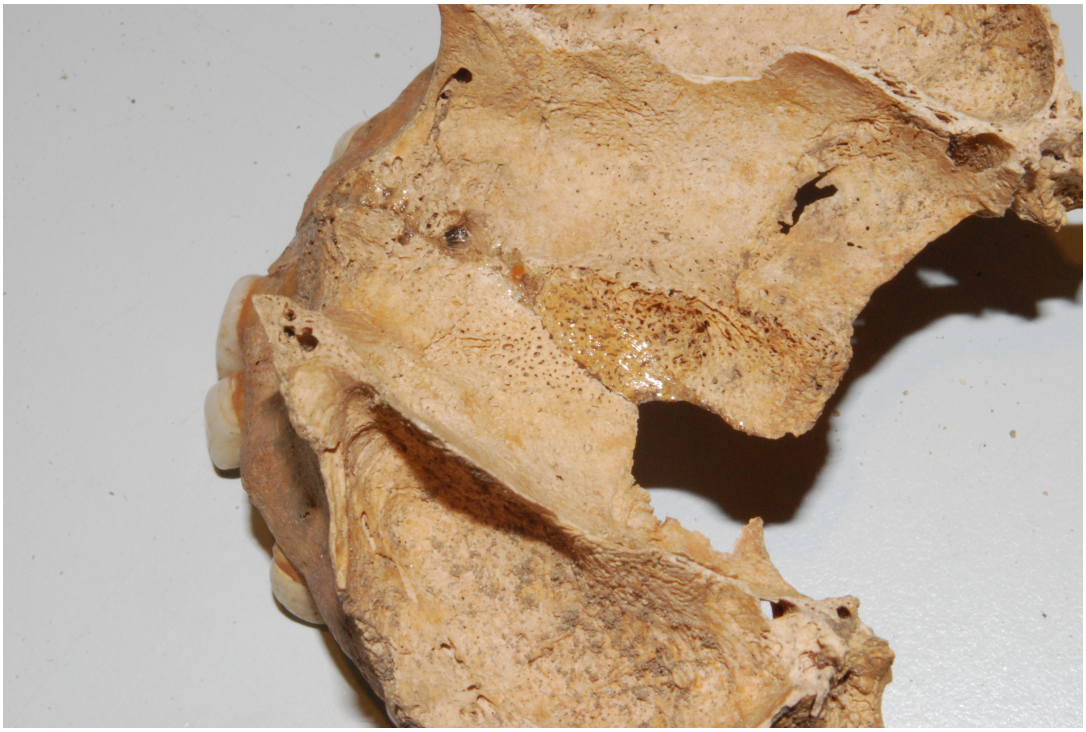

Figure 12 The skeletal changes in the right side of the nose where the bone had also been glued together. Superior view.

Figure 13 The skeletal changes in the roof of the mouth. Found on individual 334. Inferior view.

There are skeletal changes in the nose and roof of the mouth was determined to be caused by to an inflammation caused by leprosy (fig 11). However, it was harder to determine if the visible changes were due to leprosy or not since the maxillary bone was glued together (fig 12). The infection had caused pitting in the nose, which was also present in the roof of the mouth (fig 13), but the alveolar bone was not affected. The nasal spine was also affected by the infection in the nose, which can be seen in figure 11 and 12. These changes were smoother and not as aggressive as what was seen in the case of the male. This could be due to the infection being inactive during the time of death, or that the infection had not evolved as much, or a combination of both.

4. Discussion

The aim of this study was to investigate however there are evidence of leprosy in the osteological material that was excavated in 1958-1962, and if these were buried close to the church as well as in the periphery. Two cases of leprosy were indeed detected, one close to the church and one in the periphery. The frequency of leprosy is 0.5% in this material, which can be compared to the material from the northern part of the cemetery where the frequency of leprosy was 0.8%. When combining the two materials, the frequency of leprosy is 0.7%. Both individuals showed changes in the rhinomaxillary area, which implies that both suffered from lepromatous leprosy. The fact that one was buried in a stone coffin, and one without a coffin, indicates that leprosy affected individuals with both higher and lower social statuses.

The age distribution that is seen on the northern part of the cemetery, which was analyzed by Arcini (1996), shows that there was a generally low number of children under 14 years old (17%) and about half of the adults died before the age of 40. There were also a few individuals, as low as 2%, who reached 60 years or more before death (Arcini, 1996b, p. 2f). A similar pattern is seen in this material where 18,5% of the individuals is determined as juvenile, though this age division might include individuals who are older than 14. The number of children in medieval cemeteries is usually higher, around 30%, especially in the late medieval periods. There is, however, a similar distribution of age in early medieval Lund (Arcini, 1999, p. 65). It is somewhat problematic to discuss the age distribution further since the distribution of the different juvenile and adult subgroups is unknown. It would be interesting to know if there is a higher number of young children or teenagers, as well as the average age of death among adults.

Although, the low number of children could be caused by a generally lower fertility in the population. It is also possible that the general health was better, thus generating better conditions for children to survive longer. Another possibility is that the children were buried somewhere else, and are not well represented in the combined material. The taphonomic factors can also affect the number of children in the osteological material and it is possible that children were not as well preserved as adults.

There are more females (n=100) present in the analyzed material than men (n=74), with a relatively even distribution of sex with 39.6% males and 53.4% females. This could be seen in the results of Arcinis' (1996) analysis of the northern part of the cemetery as well. Though, the distribution of sex was somewhat more even in her study. The combined materials are a total of 1028 individuals and 492 could be determined as males or females. The distribution of sex is still even with 47% men and 53% women and there are no signs of a division between males and females in the grave topography (Arcini, 1996b, p. 2).

These results can be compared to Arcinis' (1999) analysis of medieval Lund where we instead see a generally higher number of males than females. The Tritianis cemetery, which was dated to 1300-1536, showed the most uniform distribution of sex, though still a slightly higher number of males. Arcini mentions how more uniform distribution of sex in Fjälkinge, dated to 900-1050 and in the St Mårten cemetery in Lund which was dated to 1050-1536 (Arcini, 1999, pp. 57, 61).

4.1 Dating and Grave Topography

Two maps have been crated to show where the individuals, who showed signs of leprosy, were buried. However, the drawings from the 1958-1962 excavation is not only not digitalized, but also hard to read. The two maps below show therefore only the placement of the two individuals with leprosy (fig 14) and the area of the two excavations (fig 15). Maps showing the distribution of the different grave types from the 1958-1962 excavation are available in the book by Weidhagen-Hallerdt (2010).

The male in grave 40 was buried without a coffin in what seems to be the outer southwest part of the cemetery (fig 14). The graves closest to grave 40 (27, 28, 30-33, 35-39) consists of wooden coffins and earth graves (type A and C) where five individuals were registered with grave type A and two individuals with coffin type C. Two of the individuals with grave type A were determined as juvenile. The remaining four individuals were buried in wooden coffins, which could be determined to a specific coffin type (Weidhagen-Hallerdt, 2010, p. appendix I). However, the individuals in

these graves were generally bad preserved. It was possible to examine possible symptoms of leprosy in five of the individuals and stature could be estimated on only three individuals. Anglert (1996) argues that it was almost impossible to determine exact coffin types for the wooden coffins on the northern part of the cemetery. Since the preservation of wood is the same in the remaining part of the cemetery it is plausible that more of these individuals were buried without coffins, particularly since no nails were found in either of the graves. The arm positions were registered for seven of these individuals; three of these were registered with position B/b or ?/b and four with position A/a or A/?. This indicates that the male in grave 40 could be contemporary or older than the nearby graves, since his arms were positioned in type B/b.

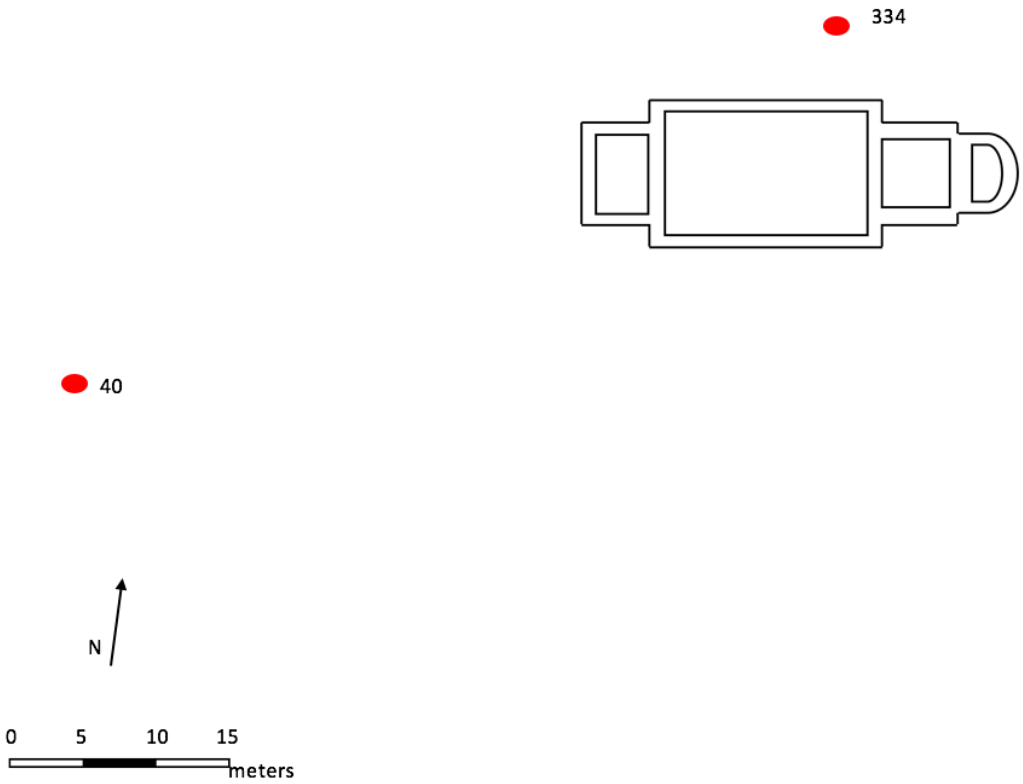

Figure 14 The placement of the two graves which showed symptoms of leprosy. Based on drawings by Margareta Weidhagen Hallerdt (2010).

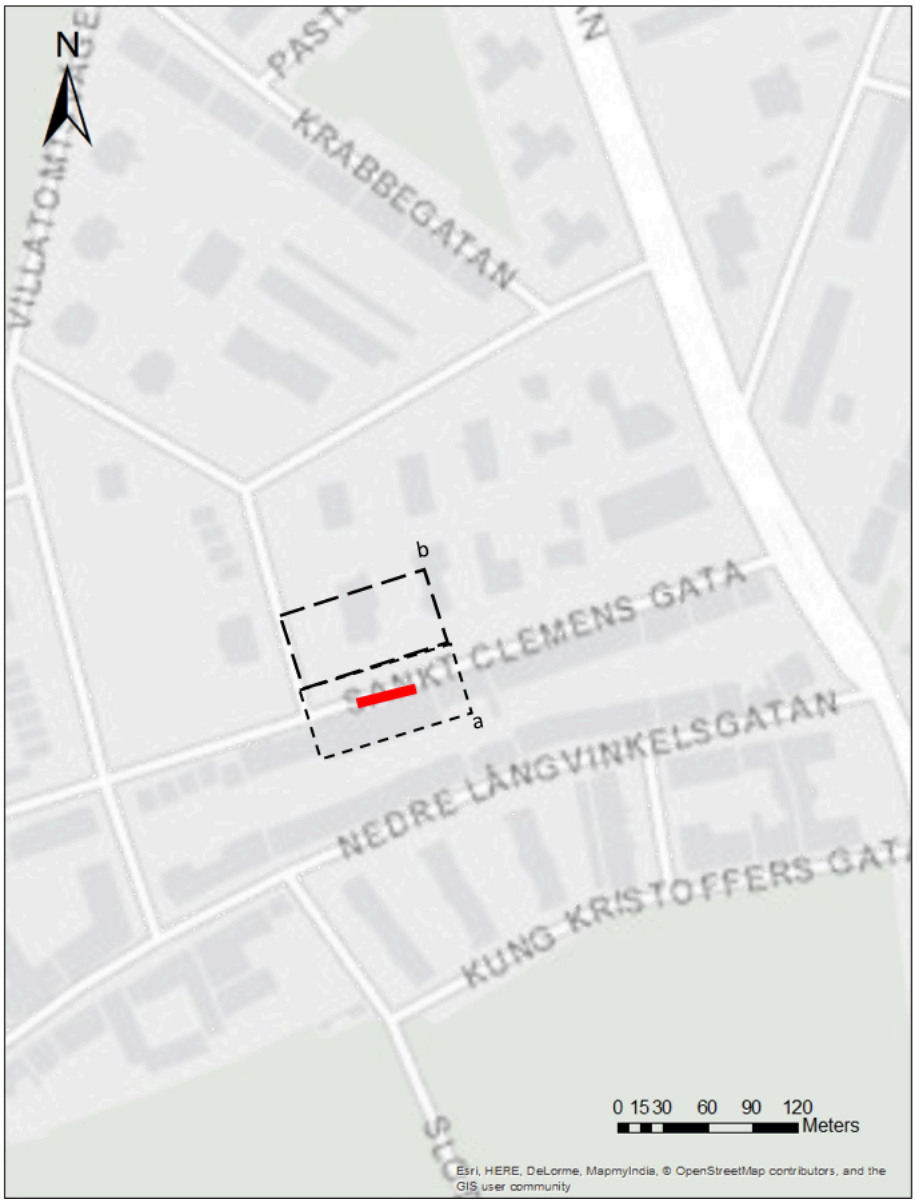

Figure 15 Map showing the area for the 1958-1962 excavation (a) and the 1980s' excavations (b). Created usling ArcGIS 10.5 by Esri.

When comparing the orientation of grave 40 and the nearby graves, it is noted that grave 40 is oriented with the head from the southwest and feet towards the northeast and the other graves are all oriented from the west to the east. Two other graves (21 and 22) are located southwest of grave 40 and have the same arm position and orientation. One of these is registered with a wooden coffin and one as an earth grave. It is possible that these are contemporary with the male in grave 40. Further south of grave 40 are grave 1-19 located, which were mainly buried in wooden coffins or without coffins. Arm

positions could be determined on twelve of the individuals and it is clear that arm position B/b was dominating. Three of the individuals were registered with arm position D/d or D/?, one individual with arm position C/c and one with arm position A/c. This is also the case for the four individuals (23-26) who are buried further northwest of grave 21 and 22, and are the ones closes towards the boarder of the cemetery. Three of these were buried without a coffin and one in a wooden coffin and arm position B/b and ?/c were registered on two individuals. One of the graves (1) contained a coin which could be dated to 1319.

It is possible to assume that the area where the male in grave 40 was buried was the outer part of the cemetery during the time of the burial. The graves that are further towards the southwest boarder are mainly registered with a contemporary arm positions, or positions that are traditionally dated to younger periods. The coin in grave 1 could more or less confirm this assumption. Although many of the individuals are assumed to have been buried in a wooden coffin, it does not seem unlikely that at least some of them were buried without coffins as well, based on the argument by Anglert (1996).

The case of the female in grave 334 is a bit different as she was buried much closer to the church, with a distance of about 5 meters (fig 14). She was buried with a sandstone close next to the head, which had been carved. Since the top side of the stone is flat, Weidhagen-Hallerdt (2010) suggests that there is a possibility that there was a lid on top of the grave, but no nails were found in the grave. Only one arm was preserved in and was positioned parallel to the body (?/a).

There are two other individuals buried in the same grave type (C4a), one (371) close to grave 334 and one (58) was found southwest of the church. The individual in grave 58 had also only one arm preserved, but the other arm was parallel to the body as well (A/?). The individual in grave 371 had both arms preserved and the arm position B/b. All three graves had a similar east to west orientation.

There is a possibility that all three graves are more or less contemporary when considering taphonomic factors, which could cause the arms to move after the burial. This would mean that when the arms are parallel to the body, such as in grave 334 and 58, they could have initially been placed with the hands above the pelvis. If variations within the four arm position types (A-D) had been registered, as it was during the 1980s excavation, it could have been possible to discuss this possibility further. However, since no pictures which shows the arms are available, it is not possible to either confirm or retract this theory.

It is generally considered that individuals who were buried closer to the church during the medieval periods had a higher social status than those who were buried in the periphery (Andrén, 2000, p. 8ff). The border of the cemetery can of course grow

outwards, as discussed above, but grave 334 is located so close to the church that it is safe to assume that the grave has been deliberately placed closer to the church. The surrounding graves are stone graves, with one or more stones placed around the body, or stone coffins and the closes graves with wooden coffins have men interpreted to belong to the older wooden church. Weidhagen-Hallerdts (2010) analysis of the coffin types shows that stone graves and stone coffins are generally placed closer to the church than graves with wooden coffins or those who are earth graves (Weidhagen-Hallerdt, 2010, pp. 50f, 63, 79). This concurs with the theory that individuals that are buried in stone coffins, or stone graves, and closer to the church would be of a higher social status.

Though most of the graves that were excavated on the northern part of the cemetery during the 1980s excavation were earth graves, there are a few cases where stone coffins and stone graves are found. However, graves containing sandstones near, similar to grave 334, the head was found in three graves (Anglert, 1996, p. 16f).

4.2 Evidence of Leprosy

Both individuals show symptoms of lepromatous leprosy, which was visible in the rhinomaxillary area where skeletal changes were formed. Lepromatous leprosy is not only the contagious form of the disease, but also the more aggressive type, and has a larger effect on the patient, compared to tuberculoid leprosy.

The male in grave 40 shows symptoms of an infection that has proceeded as far as to affecting the alveolar bone surrounding the upper front teeth. The roughness of the changes in the nose indicates that the male had an ongoing infection in the rhinomaxillary area at the time of death. Both his legs were also affected which an ongoing infection as well, which were visible on the tibiae. There is a possibility that the phalanges in the hands or feet had been affected, although this is impossible to know. Although, it is unlikely that it was possible for the male to hide the disease for the surrounding world since the disease was further developed.

The case of the female in grave 334 appears to be less severe, or at least the disease seems to be less developed. However, there are visible changes in the nose that were caused by leprosy. There were less bones preserved in this grave, which could be due to the excavation method rather than taphonomy since the bones that were present are well preserved. It was not possible to examine the hands or the feet, which makes it impossible to know if these were affected by leprosy, but there are no visible signs of infection on the other bones. Although, there is no sign on infection on the remaining bones.

Ulceration of the soft tissue in the nasal area is commonly seen in the earlier stages of leprosy, however the disease can alternate between an acute phase and an inactive phase. The disease is affected by factors such as the patients' immune system, as well as pregnancy or malnutrition. The skeletal changes in the rhinomaxillary area is probably caused by the alternation of the two phases. This means that a patient who has experienced more severe symptoms can have periods where the disease appears to be less aggressive, and vice-versa (Ortner, 2002, p. 74). The edges of the skeletal changes, which could be seen in the nasal area of the individual in grave 334, were smoother which is an indication of an inactive phase of the disease. However, although the skeletal changes are less severe, the disease is probably not in one of the earliest stages. It has been suggested by Orthner that the acute phase, where the destruction of the bone occurs, can be very brief and that it is common that the patient dies before the bones are further damaged (Ortner, 2002, p. 74). This could mean that even though the infection appears to be less severe, it is plausible that the female experienced an active phase of the disease at the time of death.

It is likely that the female experienced other symptoms other than the infection that is seen in the rhinomaxillary area, such as loss of sensation and ulcerations. If the disease has developed rapidly, it is possible that the severity of the symptoms is not reflected in the bone material (Ortner, 2002, p. 73f). In the light of this it is plausible to argue that the female might have experienced a more aggressive, or more rapid development, of the disease which did not leave as distinct traces on the bones. A possible cause of death could be sepsis due to secondary inflammation in wounds caused by leprosy, which is one of the most common cause of death among lepers (Arcini, 1999, p. 113; Roberts and Manchester, 2005, p. 245).

It is also possible that the female shows less severe symptoms because of a better health status. If she had a higher social status, which the grave and placement of it in relation to the church, indicates, it is plausible that she experienced better living conditions, which could result in a better immune system. This would mean that she would have had better prerequisites when the disease becomes active. The cause of death could still be because of a secondary infection caused by leprosy, but the symptoms of leprosy itself could have been less severe. It is also possible that the cause of death is something unrelated to leprosy.

This is one of the paradoxical problems that occurs when discussing human remains in archaeological contexts. Though it appears that the female was less effected by the disease it is possible that she instead experienced a more rapid and aggressive version. It is as likely as if she would have experienced a milder version of the disease. This is a problematic discussion to pursue since the two scenarios leave similar traces on the bone (Wood *et al.*, 1992). However, it is of importance to not neglect either possibility.

A study of the presence of leprosy in five cemeteries in Schleswig, on the Danish-German border, show that females who were infected with leprosy ha an elevated risk of dying. Men who were infected with leprosy, on the contrary, tended to live longer than those who were not infected. The age-at-death- was, however, generally lower than what has been seen in medieval Denmark and it was suggested that a higher number of individuals were probably infected with leprosy, but died before they showed any symptoms (Boldsen, 2009).

Though it has been discussed that leprosy is commonly spread within families, it is highly unlikely that the two infected individuals would be related. This is more likely in cases where lepers are buried together, which could either be a sign of stigmatization or an effect of the tradition of burying family members close to one another (Arcini, 1999, p. 131). It is also not currently possible to date the two graves to the same period, based on the arm positions.

The frequency of leprosy in the analyzed material is 0.5%. A lower frequency than was seen in the northern part of the cemetery (0.8%) was somewhat expected since most of the individuals in this material was buried closer to the church. When combining the two results we see a frequency of leprosy that is 0.7% on the total cemetery, where 4 were women and 3 were men (Arcini, 1996b, p. 9).

This result can be compared to the large combined material from medieval Lund. 3,305 individuals were examined by Arcini (1999) and a total of 43 cases of leprosy were detected, which is a frequency of 1.3%. However, since most of the individuals with leprosy was from the sample of the material which was dated to 990-1100, the frequency is calculated to be 2.6% – 4.5% from this period. The majority of these individuals, 21, were men and 15 individuals were women. Sex could not be determined on seven individuals with symptoms of leprosy. 34 of the 43 cases occurred on the Tritianis cemetery, which has, as St Clemens, both a wooden and a stone church and the cemetery is dated to 990-1100. 8 cases were found on the cemetery which belonged to the wooden church in Kattesund that is dated to 1050-1100. One individual with leprosy was buried on the cemetery of the Tritianis stone church, but was dated to 1300-1536. At the Tritianis cemetery, all individuals who were infected with leprosy, with the exception of one, were found in the outer part of the cemetery. The 8 individuals which were buried at the Kattesund cemetery were buried in the northern part. The one individual who could be dated to 1300-1536 were, on the contrary, buried closer to the stone church (Arcini, 1999, pp. 118, 121).

The most commonly found indication of leprosy was the rhinomaxillary syndrome, which were found in 31 individuals. However, the nasal cavity could only be examined in 34 individuals (Arcini, 1999, p. 121).

4.3 Social Status and Leprosy

When comparing the male in grave 40s' stature to the mean stature for men, he is 3 cm shorter than average. Most men tended to be in the range of 165-170 cm or 171-175 cm. The male in grave 40 is, however, in the shorter third of the population on the cemetery. This could indicate that the male could have experienced malnutrition in childhood and adolescence, thus resulting in a lower stature. It is therefore plausible that he was of a lower social status during his childhood. The male was buried without a coffin in what seems to be the periphery during the 13th century. The placement and the type of the grave is traditionally linked to a lower social status. It is therefore likely that the male had a lower social status during adulthood as well.

Individuals with leprosy were generally buried in the periphery, but it is not clear that individuals with leprosy were of a lower social status before they were infected, or if the lower status is a result of contracting the disease (Arcini, 1999, p. 130f). In this case it is plausible that the males' social status was not a direct consecution of the leprosy infection. Though, since the infection was in such a late stage where it was probably noticeable for others, it is plausible that the males' social status was affected further.

The female in grave 334s' stature remains unknown due to taphonomic factors. However, she was buried in a stone grave with a carved sandstone placed close to the head. The grave was placed about five meters from the stone church, which is a place that is commonly thought to be connected to a higher social status. This conflicts with the general conception of how individuals with leprosy were usually of a lower social status. It is plausible that the female was of a higher social status, and although individuals in this social group is not traditionally not considered to be as affected by the disease, this female was.

The mean height is estimated to be lower for males than what was calculated from the northern part of the cemetery. It was estimated to be 172 cm, where the mean height for males was calculated to be 167 cm, which is a difference of 5 cm. Since height could only be estimated on 20% of the material, and 55% of the males, it was investigated however the grave types created a bias. If the majority of the individuals, from which stature could be estimated, were buried in an earth grave, the estimated mean height could have been shorter rather than reflecting the true mean height for the material. A non-parametric test was done, using an MWU-analysis in R (R Core Team, 2016). Although the test showed that there was a larger variation in height and grave type for males than females, the result was not of a statistical significance and showed that the variation is not large enough to be caused by coincidence. It is not plausible that the difference in male height is caused by different methods, or taphonomy, since the mean height for the females was calculated to be the same (160 cm) as for the northern part of the cemetery.

The difference in stature could be caused by genetic factors (Steckel, 1995) or malnutrition. Though the northern part of the cemetery is considered to be more or less contemporary with the material from the 1958-1962 excavation it is still possible that the individuals that were buried closer, or south of, the church had experienced diseases despite of a higher social status. The fact that an individual with leprosy is found close to the church could be an indication of this. Another possibility is that individuals in this part of the cemetery experienced more severe years, with for example bad harvest, during their childhood or adolescence, which resulted in malnutrition, a general lower health status, and a shorter mean height. Males are also considered to be more susceptible to environmental stress, which could explain why we see a difference in male stature, but not in female (Vercellotti, Stout and Sciulli, 2011; Steckel, 2012; Stinson, 2012; Tornberg, 2018).

It is hard to determine which one of these theories that is the correct one, since it is also possible that it is a combination of these. However, it seems most unlikely that the difference is caused by a bias. It is also statistically unlikely that the individuals for which stature could not be estimated is the taller individuals. The difference in height should therefore be seen as a general difference between the northern part of the cemetery and the part that is closer to the church.

A comparison from the St Petri cemetery in Helsingborg, which was located close to the St Clement church, showed that both males and females from the northern part of the St Clement cemetery tended to be shorter than those from the St Petri cemetery. The mean height for males were 173.3 (1.6 cm higher) at the St Petri cemetery, and the mean height for females were 161.7 (0.8 cm higher) (Arcini, 1996b, p. 3). There is a larger variation in the male mean stature, which could be because of males' susceptibility to environmental stress, as discussed above. It is possible that the health status was higher for the individuals that were buried at the St Petri cemetery than for those who were buried at the St Clement cemetery.

The St Petri church is described to be a parish church as well as the St clement church, and the two churches are more or less contemporary. However, as the St Clement church was for the urban people, the St Petri church was for individuals who lived in the nearby country side villages (Bååth, 1933, p. 317). The variation of male mean stature could indicate that the urban inhabitants experienced a higher stress, possibly by malnutrition or disease, which affected the stature. It can also be caused by genetic factors.

Arcini (1999) mentions, in her analysis of the medieval material from Lund, that individuals with leprosy were only buried on the cemeteries before building of the leprosy hospital between 1140 and 1150. Though, the tradition of burying lepers at the cemeteries which are not connected to a leprosy hospital is unusual in the Nordic

countries. These hospitals increased in Europe during the 12th and 13th century, which the largest increase in the Nordic countries between 1250-1299.

A similar burial pattern as the one that is seen in medieval Lund, where lepers were buried in the periphery, can be found in bishop's cemetery in Sigtuna and the grave-field in Fjälkinge. Although all of the lepers were buried in the periphery at the Fjälkinge grave-field, there is an example of one individual who were buried closer to the outer boarder of the Sigtuna cemetery. Arcini argues that the placement of the graves does not necessarily reflect the stigmatization of the disease itself, but that leprosy more often affected individuals with a lower social status, who were buried in the outer part of the cemetery (Arcini, 1996a, 1999, p. 131; Kjellström, 2005, p. 80f).

This phenomenon could perhaps be reflected in this analysis as well. The male in grave 40, who were buried in the outer part of the cemetery, shows indication of a lower status. This is reflected in the grave type, as he was buried without a coffin, the placement of the grave and in the estimated lower stature. It is possible that the males' social status was unaffected by the disease, but it is also possible that individuals with a lower social status was further affected by the stigmatization that surrounds the disease.

Although, when comparing the male with the female in grave 334, she appears to have a higher social status. Although, the stature could not be calculated, she is buried close to the church in a stone grave with a carved sandstone close to the head. This grave type and the placement is, as previously discussed, traditionally associated with a higher social status. Since she shows symptoms of leprosy, despite of her burial, it is possible that leprosy did not necessarily affect social status in medieval Helsingborg. It is also clear that leprosy affected individuals with both a higher and a lower social status in Helsingborg.

None of the individuals (33 of 75) which can, with certainty, be connected to the wooden church showed symptoms of leprosy. Although, the bones in which symptoms are typically found, such as the skull, hands, and feet, could only be examined in seven of these individuals. Stature could be estimated on seven individuals and four of these hade a higher stature than average. Weidhagen-Hallerdt suggests that a worrier elite was buried at the cemetery which belonged to the wooden church, which she based on the fact that she saw that these individuals were mainly tall males (Weidhagen-Hallerdt, 2010, p. 105f). Although, when comparing her results to the results from this analysis it seems unlikely that the individuals that were buried on the cemetery of the wooden church belonged to a warrior elite. Sex could be estimated on 14 of the 33 individuals and 57% of these were determined as males and 43% as female. However, it is possible that the individuals on the cemetery of the wooden church were of a higher status and that the function of the church changed when the stone church was built.

The recent studies of aDNA and leprosy shows the potentials of how this research field can, and probably will, develop in the future. Though studies as these can help us gain further knowledge of how leprosy was spread in the medieval Europe, it can also be an important tool when diagnosing remains where the postcranial skeleton is not preserved as well (Schuenemann *et al.*, 2013, 2018; Krause-Kyora *et al.*, 2018).

5. Conclusion

It is clear that individuals who were buried closer to the church, than those who were buried at the northern part, were infected with leprosy as well. The frequency of leprosy (0,5%) is a bit less than what was found on the northern part of the cemetery (0,8%). This could be because the graves in this material are located closer to the church. When combining the results from the two parts of the St Clement cemetery, the frequency of leprosy is 0.7%. This is lower than what has been seen in Lund, where the frequency 2.6-4.5%. The lower frequency could be explained by the taphonomic rate of the material, since osteological symptoms of leprosy could not be investigated in all individuals. It is also possible that individuals who had contracted leprosy died before they were affected. However, since the age-at-death is not much lower than what is seen in Lund, this is a less likely possibility.

The male in grave 40, which was dated to the 13th century, shows indications of a lower social status than the population that was buried at the St Clement cemetery. His estimated stature (164.5 cm) is three centimeters shorter than the estimated average height for males (167 cm). The male was also buried, without a coffin, in the periphery of the cemetery. The grave type and the placement of the grave are traditionally linked with a lower social status. A shorter stature can also be an indication of lower stature. Though a shorter height can be caused by genetics, it can also be affected by malnutrition or diseases during childhood and adolescence. If the male had a lower social status, it is plausible that his stature was affected by inferior living conditions.

It is also plausible that the males' social status was affected by the leprosy infection, thus resulting in him being buried even further from the church. However, we see evidence that one individual, the female in grave 334, dated to the 11th – 12th century, was buried close to the church, despite showing osteological symptoms of leprosy. She was buried in a stone grave with a carved sandstone next to the head, which is a grave type that is connected to a higher social status, as well as the placement of the grave which was about five meters from the church.

The male shows more severe symptoms of leprosy than the female, though this does not necessarily mean that the male was worse affected by the disease, but perhaps rather that he survived longer. Therefore, it is possible that the female experienced a more

aggressive course of disease. Boldsen (2009) suggests that females experienced a higher risk of dying after being infected with leprosy. Though a faster course of disease can be explained by other factors, such as malnutrition, low immune system, or pregnancy, this is another possibility to why she showed less severe symptoms. We can, however, see that both individuals showed similar skeletal changes in the rhinomaxillary area, which are only seen in lepromatous leprosy, the more aggressive form of leprosy.

The average stature among males was lower than what had previously been seen at the northern part of the cemetery, where the average height was estimated to be 172 cm. It remains unknown why the males tend to be shorter at this part of the cemetery. However, this could possibly be because of a lower health status among the individuals that were buried closer, or south of the church, but it could also be caused by genetics. Though it is unexpected to see decrease in stature closer to the church, the MWU-test showed that the result was not affected by an over representation of one grave type. It is also unlikely that the result is caused by a bias.

We can see from this analysis that leprosy affected social groups with both a higher and lower social status. This means that the placement of the graves does not necessarily reflect a social stigmatization of those who were infected by leprosy in Helsingborg, which has also previously been discussed by Arcini (1999). Nonetheless, the individuals who were buried at St Clement cemetery was indeed affected by leprosy. Both those who were infected themselves, but also those who had the disease in their periphery.

6. Summary

This thesis investigates the presence of leprosy at the medieval St Clement cemetery in Lund. The St Clement church is one of the oldest medieval churches in Helsingborg and is thought to have been built during the late 11th century (Anglert, 1996, p. 25). The area of the church and cemetery was excavated several times, but a large excavation was performed during 1958-1962. 441 graves were excavated and analyzed by Margareta Weidhagen-Hallerdt (2010), but the results was first published 50 years later in 2010 (Weidhagen-Hallerdt, 2010). New excavations were performed during the 1980s, but this time of the most northern part of the medieval cemetery. A full osteological analysis was made on the skeletal remains from the 611 graves which were excavated and symptoms of leprosy were detected on five individuals (Anglert, 1996; Arcini, 1996b).

Since it was already known that there was a presence of leprosy at the cemetery, the aim of this thesis was to investigate however there is evidence of leprosy in the material that was excavated in 1958-1962 as well, and if these individuals were buried closer to the church or in the periphery. This thesis also investigates plausible socioeconomic differences between individuals that show evidence of leprosy and those who do not, which is reflected in stature, grave type and grave topography. 417 individuals were available for analysis and these are currently curated by Kulturmagasinet in Helsingborg.

I was possible to determine age for a high amount (98,6 %) of the individuals due to the wide categories for age, where individuals were only determined as adult or juvenile. 80% of the individuals were determined as adults and 18,5% as juvenile. It was possible to determine sex on 55,8% of the adult individuals. There was a relatively even distribution of sex with 39.6% males and 53.4% females. Stature could be estimated for 41 males where the shortest was 152 cm and the tallest was 184 cm. The average height among males was 167. The average height among females was 160 cm, where the shortest was 147 cm and the tallest was 174 cm.

It is also seen that the males that were included in this study tended to be shorter than what was seen in the northern part of the cemetery. Though some ideas are presented, the reason for why this difference occurs remain unknown.

Leprosy was detected in two individuals, one male and one female, which is a frequency of 0.5% in this material. Both individuals show symptoms of lepromatous leprosy, which was visible in the rhinomaxillary area where skeletal changes were formed.

The male in grave 40 showed symptoms of an infection that had proceeded as far as to affecting the alveolar bone surrounding the upper front teeth. The roughness of the changes in the nose indicated that the male had an ongoing infection in the rhinomaxillary area at the time of death. When comparing the stature of the male in grave 40s' to the mean stature for men, it shows that he was 3 cm shorter than average. He was buried in the periphery of the cemetery and the arm positions suggest that he possibly lived during the 13th century.

The female in grave 334 showed skeletal changes in the nose and roof of the mouth, which was determined to be caused by to an inflammation caused by leprosy. She was buried in a stone grave with a flat cut sandstone close to the head (C4a) and there is a possibility that the grave could have had a lid. The grave was also place about five meters from the church. The arm position indicated that the grave could be dated to either the 11th-12th century or during the 13th century. The case of the female appeared to be less severe, or at least the disease seemed to be less developed. It is plausible to argue that the female might have experienced a more aggressive, or more rapid development, of the disease which did not leave as distinct traces on the bones.

The results from this study show that leprosy affected individuals with both a higher and a lower social status, and that individuals with leprosy could be buried close to the church as well as in the periphery. The male in grave 40 showed indications of a lower social status than the population that was buried at the St Clement cemetery. This is reflected in his grave type, position of the grave and stature. Though stature could not be estimated from the female in grave 334, her grave type, as well as the placement of the grave, indicates a higher social status. It is therefore suggested that the placement of the graves does not necessarily reflect a social stigmatization of leprosy.

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Appendix I

The database, which contain the results from the analysis. The IDs that are marked with a * contain differences from the study by Weidhagen-Hallerdt (2010).

ID	A/B	Ålder	Kön	Lepra	Lårbensmått	Kroppslängd Sjøvold	Armställning	Gravtyp
1		Adult	Obest	Går ej att se	-		-	A
2*	b	Adult	Obest	Nej	-		-	A8a
2*	a	Adult	Kvinna?	Nej	-		-	A8a
3	b	Juvenile		Går ej att se			-	A8b
3	a	Adult	Obest	Går ej att se	-		D/d	A8b
4		Adult	Obest	Går ej att se	-			A8a
5		Adult	Obest	Går ej att se	-		-	A8a
6*		Adult	Man	Nej	43,2	160,8	D/d	A8a
7		Obest	Obest	Går ej att se	-		-	A
8*		Adult	Kvinna	Nej	43,4	161,3	A/c	A
9*		Adult	Kvinna?	Nej	-		?/b	A
10*		Adult	Obest	Nej	-		B/b	A8a
11*		Adult	Kvinna?	Nej	-		B/b	A8a
12*		Adult	Kvinna?	Nej	-		B/b	A8a
13*		Adult	Obest	Går ej att se	45,3	165,9	B/b	A8b
14	b	Juvenile		Nej			B/b	A
15*		Adult	Man?	Nej	45,5	166,4	B/b	A8b
16	a	Juvenile		Nej			D/?	A
16*	b	Juvenile		Går ej att se			C/c	A
17*		Adult	Obest	Nej	-			A
18	a	Juvenile		Nej				A8b
18	b	Juvenile		Nej				A8b
19*		Adult	Kvinna?	Nej	-		C/d	A
20*		Adult	Obest	Går ej att se	-		B/a	A
21*		Adult	Obest	Går ej att se	45,6	165,2	B/b	A
22*		Adult	Kvinna?	Går ej att se	-		B/b	A8b
23		Adult	Kvinna	Nej	-			A
24*		Adult	Obest	Nej	-		?/c	A
25*		Adult	Obest	Går ej att se	-		B/b	A7
26*		Juvenile		Nej				A
27*		Adult	Obest	Går ej att se	-		A/a	C
29*		Juvenile		Nej				A

30*		Juvenile		Nej				A
31		Adult	Obest	Går ej att se	-			A
32*		Adult	Obest	Går ej att se	48,1	172,9	?/b	A5
33*		Adult	Obest	Går ej att se	40,8	54,9	B/b	A5
35*		Juvenile		Nej				A6
36		Adult	Obest	Går ej att se	-		A/?	A
37*		Adult	Man?	Går ej att se	50,7	179,3	A/a	A
38		Adult	Man?	Nej	-		A/a	A8a
39*		Adult	Kvinna	Nej	-		B/b	C
40*		Adult	Man?	Ja	44,7	164,5	B/b	C
41*		Juvenile		Nej			B/b	A6
42*		Juvenile		Nej			B/b	A6
43*		Juvenile		Nej			A/b	A6
44*		Juvenile		Nej			?/b	A6
45*		Juvenile		Nej			A/b	A7
46*		Adult	Obest	Går ej att se	-			A
47		Juvenile		Nej				A
49*		Adult	Kvinna	Nej	42	157,84	C/c	C
50*		Adult	Obest	Går ej att se	51,7	181,8	A/a	C
51		Adult	Obest	Går ej att se	-			C
52		Juvenile		Nej				C
53*		Juvenile		Går ej att se			B/b	A8a
54		Adult	Kvinna?	Går ej att se	-		B/b	A
55*		Juvenile		Nej			A/b	A
56		Adult	Obest	Går ej att se	-		B/b	C
57*		Adult	Kvinna?	Nej	-		A/a	C
58		Adult	Obest	Nej	-		A/?	C4a
59		Adult	Obest	Nej	-			C
60*		Adult	Obest	Nej	-			C
61*		Adult	Obest	Nej	-			C
62*		Adult	Kvinna?	Nej	-			A
63*		Adult	Obest	Går ej att se	42,3	158,6	A/a	A
64*		Juvenile		Nej			?/a	C
65		Adult	Obest	Går ej att se	-			C
66*		Juvenile		Nej			A/?	A
67		Adult	Obest	Nej	-			C
68*		Adult	Obest	Går ej att se	-			C
69*		Adult	Obest	Nej	40,1	143,1		C
70*		Adult	Obest	Nej	46,8	169,7	A/a	C

71*		Adult	Obest	Går ej att se	47,5	171,4	B/a	C2a
72*		Juvenile		Nej			B/b	A
73*		Adult	Kvinna	Nej	42,1	158,1	B/b	C2a
74*		Adult	Obest	Nej	-			A
75*		Adult	Obest	Nej			B/b	C
76*		Adult	Obest	Nej	-		A/a	A
77		Juvenile		Nej			C/c	A8a
78*		Juvenile		Nej			?/a	A
79*		Juvenile		Nej				A
80*		Adult	Obest	Nej	-		A/a	A
81*		Adult	Obest	Nej	-		-	C
82*		Adult	Obest	Nej	-			C
84*		Juvenile		Går ej att se			C/c	A8b
85*		Juvenile		Går ej att se			A/a	A
86*		Adult	Ambiv.	Nej	-		?/a	A
87*		Adult	Man	Nej	48	172,7	A/a	A
88*		Adult	Man?	Går ej att se	46,2	168,2	A/a	A
89		Juvenile		Nej			C/d	A
90		Adult	Obest	Går ej att se	-		A/?	C
91*		Adult	Obest	Nej	-		?/a	C
92		Juvenile		Går ej att se				C
93		Adult	Obest	Går ej att se	-			C
94*		Adult	Obest	Går ej att se	-			C
95*		Adult	Ambiv.	Går ej att se	45,3	165,9	B/b	C4c
96*		Juvenile		Går ej att se			B/b	C
97*		Adult	Obest	Nej	-		A/a	B
98		Adult	Obest	Nej	-			B
99*		Adult	Obest	Nej	-			C
101		Juvenile		Går ej att se				C
102*		Adult	Kvinna	Nej	43,1	160,5	C/c	C
103*		Adult	Ambiv.	Nej	-		C/c	A
104*		Adult	Kvinna	Nej	43,4	161,3	B/c	C
105*		Adult	Kvinna	Nej	46,4	168,7	C/b	C
106*		Adult	Man?	Nej	47,9	172,4	D/?	A5
107*		Adult	Man?	Nej	47,5	171,4	C/d	C
108*		Juvenile		Går ej att se			A/a	C
109*	a	Adult	Man?	Går ej att se	-		A/a	A2
109*	b	Adult	Obest	Går ej att se	-			
110*	a	Adult	Kvinna?	Går ej att se	40,5	154,1		
110*	b	Adult	Kvinna?	Går ej att se	-			

111*	a	Adult	Ambiv.	Nej			?/b	B3
111*	b	Adult	Obest	Går ej att se	46,6	169,2		A2
112*		Adult	Kvinna?	Nej	-			B
113*		Adult	Kvinna?	Går ej att se	41,9	157,6	A/a	C
114*		Adult	Ambiv.	Nej	45,5	166,5	D/c	A
115*		Adult	Man	Nej	47,1	170,4	C/d	A5
116*		Adult	Kvinna	Nej	37,7	147,2	C/d	A5
117*		Adult	Man	Nej	-		C/c	C
118*		Adult	Kvinna?	Går ej att se	-		C/d	A5
119		Adult	Obest	Går ej att se	-		A/a	B
120*		Adult	Kvinna	Nej	45	165,5	A/a	B3
121		Adult	Kvinna?	Nej	42,9	160	A/a	C4c
122*		Juvenile		Går ej att se			A/?	C1
123*		Adult	Man	Går ej att se	48,3	173,4	A/a	B1b
124*		Adult	Man	Nej	42,9	160	C/?	C
125*		Adult	Man?	Nej	-		B/d	A7
126*		Adult	Ambiv.	Nej	48,7	174,4	C/c	C
127*		Adult	Ambiv.	Går ej att se	46	167,7	D/d	A
128*		Adult	Man?	Nej	46,4	168,7	C/c	A
129*		Adult	Kvinna?	Går ej att se	45	165,3		B
130*		Adult	Man?	Nej	-		A/a	B3
131		Adult	Obest	Går ej att se	-		A/a	B
132*		Adult	Man	Nej	50,8	179,6	A/a	B3
133*		Adult	Man?	Går ej att se	46,1	168	A/a	B2a
134*		Adult	Man	Går ej att se	45	165,25	A/a	B3
135*		Adult	Kvinna	Nej	40,3	153,6	A/b	B3
136*		Adult	Man	Går ej att se	-		B/b	B4a
137*		Adult	Man	Går ej att se	39,8	152,4	B/c	B
138*		Adult	Kvinna	Nej	41,4	156,4	?/c	C
139*		Adult	Ambiv.	Nej	47,2	170,7		
140*		Adult	Man?	Nej	48,2	173,4	B/?	A5
141		Juvenile		Går ej att se				B4b
142*		Adult	Obest	Går ej att se				B
143*		Adult	Obest	Går ej att se	48,3	173,4		B
145*		Adult	Kvinna	Går ej att se	43,9	162,5	B/b	B2b
146*		Adult	Man	Nej	-		B/b	B1b
147*		Adult	Kvinna	Går ej att se	44,4	163,8	A/a	B3
148*		Adult	Man	Går ej att se	45,6	166,7	A/a	B3
150		Adult	Obest	Går ej att se	-			A
151		Adult	Obest	Går ej att se	-			A

152*		Adult	Man?	Nej	44,7	164,5	B/?	B
153*	a	Adult	Obest	Går ej att se	-		A/?	B2a
153	b	Adult	Obest	Nej	-			C
154*		Adult	Obest	Går ej att se			A/?	B4b
155		Adult	Obest	Går ej att se	-		A/a	A
156*		Adult	Obest	Går ej att se	-		?/a	C
157		Adult	Obest	Nej	-		B/a	A
158*		Juvenile		Nej				A8b
159*		Juvenile		Nej				A8b
160		Adult	Kvinna					
161		Adult	Man?	Nej	-		B/b	A8
162*		Adult	Kvinna?	Nej	-		B/?	A7
163		Juvenile		Nej				A6
164*		Adult	Kvinna	Nej	42,4	158,8	B/b	C
165*		Adult	Ambiv.	Går ej att se	-		B/b	A
166*		Adult	Kvinna	Nej	-		B/b	A4
167*		Juvenile		Går ej att se				A
169*		Adult	Kvinna	Går ej att se	-		?/b	C
170*		Adult	Man	Nej	-		?/b	C
171*		Adult	Man	Nej	-		?/a	C
172		Adult	Obest	Går ej att se	-			C
173*		Adult	Kvinna	Nej	-		A/a	C
174*		Adult	Man?	Går ej att se	46,1	167,9	A/a	A
175		Adult	Obest	Nej	-		A/?	B3
178*		Adult	Obest	Går ej att se	-		B/a	A1
179*		Juvenile		Går ej att se				A3
180*		Adult	Kvinna?	Nej	42,2	158,3	D/d	A5
181*		Adult	Obest	Nej	-		B/b	A5
182*		Adult	Man	Nej	-		C/c	C
183*		Adult	Obest	Går ej att se	-		B/a	A2
184*		Adult	Obest	Går ej att se	-		A/?	A2
185		Juvenile		Går ej att se				A1
186*		Adult	Man?	Går ej att se	45	165,25	A/a	A1
187*		Adult	Obest	Går ej att se	-		-	B3
188*		Adult	Obest	Går ej att se	41,5	156,6	-	B4a
189*	b	Adult	Man?	Nej	44,7	164,5	B/b	B3
190*		Adult	Man	Går ej att se	-		B/b	A2
193*		Juvenile		Går ej att se			?/b	A
194		Adult	Obest	Går ej att se	-			A

195		Adult	Obest	Går ej att se	-			A1
196		Adult	Obest	Går ej att se	-			A4
197*		Adult	Obest	Går ej att se	-		A/?	A1
198*		Adult	Man?	Går ej att se	-		A/a	A2
199*		Adult	Obest	Går ej att se	43,6	161,8	?/b	A2
200*		Adult	Kvinna?	Nej	-		D/d	A
201*		Adult	Man?	Nej	44,9	165	?/b	C
202*		Adult	Obest	Går ej att se	-		A/?	A2
203*		Adult	Man?	Nej	46,9	169,9	A/?	A
204*		Adult	Man?	Nej	-		A/b	C (A3)
205*		Adult	Obest	Går ej att se	-		A/a	C (A3)
206*		Adult	Kvinna	Nej	42,5	159	D/d	C
207*		Adult	Obest	Går ej att se	-		D/d	A7
208*		Adult	Obest	Går ej att se	-		?/a	A3
209*		Adult	Obest	Går ej att se	47,6	171,7	B/b	A1
211*		Adult	Kvinna?	Nej	48,4	173,6	C/c	C
212		Juvenile		Går ej att se			?/c	A
213*		Adult	Obest	Går ej att se	46,3	168,5		C
214*		Adult	Ambiv.	Går ej att se	46,1	168	A/b	C
215*		Adult	Man?	Nej	52,5	183,8	C/c	C
216		Adult	Obest	Går ej att se	-			B
217		Adult	Obest	Går ej att se	-			C
218*		Juvenile		Går ej att se			D/d	C
219*		Adult	Kvinna	Går ej att se	45,5	166,5		C
220*		Adult	Kvinna?	Nej	-		A/?	B3
221*		Adult	Obest	Går ej att se	-			C
222*		Adult	Kvinna	Nej	-			B4b
223*		Adult	Kvinna?	Går ej att se	45,2	165,7		C
224*		Juvenile		Nej			?/c	C
225*		Juvenile		Går ej att se			?/c	C
226*		Juvenile		Nej			?/d	C
227*		Adult	Man	Nej	-		D/d	C
228*		Adult	Obest	Går ej att se	49,1	175,6		B
229*		Adult					A/?	B4a
230*		Adult	Kvinna	Nej	40,3	153,6	C/c	A
231*		Juvenile		Går ej att se			B/a	A3
232*		Adult	Kvinna	Nej	46,7	169,4	C/c	A
234		Adult	Obest	Går ej att se	-		B/?	A1
235*		Adult	Man	Nej	-		C/d	A7
236*		Adult	Obest	Går ej att se	-		A/a	A1

237*		Adult	Obest	Nej	-			A1
238*		Adult	Obest	Går ej att se	-		B/a	A3
239*		Juvenile		Går ej att se			B/?	A3
240*		Adult	Obest	Går ej att se	-		B/a	A2
241*		Adult	Kvinna?	Går ej att se	46,8	169,7	A/a	A3
242	a	Adult	Obest	Går ej att se	-		A/a	C
243*		Adult	Kvinna?	Nej	40,5	154,1	A/a	C
244*		Adult	Kvinna?	Nej	-		A/a	A3
245*		Juvenile		Nej			A/a	C
246*		Adult	Kvinna	Nej	-		A/a	C
247*		Adult	Man	Nej	49	175,1	A/a	C
248*		Adult	Man?	Nej	-		A/a	C
249*		Adult	Kvinna?	Går ej att se	-		A/b	C
250*		Adult	Man	Nej	-		?/a	C
251*		Adult	Man	Nej	41,2	155,8	A/a	C
252*		Adult	Man	Nej	-		?/a	C2a
253*		Adult	Ambiv.	Nej				
255*		Adult	Obest	Går ej att se	-		B/b	C
256		Adult	Obest	Går ej att se	-			C
257*		Adult	Obest	Går ej att se	-		B/a	C
258		Adult	Obest	Går ej att se	-			A
259*		Adult	Obest	Nej	-		D/d	C
260*		Adult	Kvinna?	Går ej att se	-		B/b	A8b
261		Adult	Obest	Går ej att se	-			C
262*		Juvenile		Går ej att se				A7
263		Juvenile		Går ej att se				C
265*		Adult	Kvinna	Nej	-		?/b	A
266*		Adult	Obest	Går ej att se	-		?/b	C
267		Adult	Obest	Går ej att se	-			A
268*		Adult	Obest	Nej	-		A/a	A
269*		Adult	Man?	Går ej att se	-		A/a	C
270*		Adult	Kvinna?	Går ej att se	-		?/a	C
271*		Adult	Kvinna?	Går ej att se	-		D/d	A
272		Adult	Obest	Går ej att se	-		A/a	A
273*		Adult	Kvinna?	Nej	-		B/b	A4
274*		Adult	Obest	Nej	-		?/a	A
275*		Adult	Obest	Går ej att se	-		A/a	C
276		Adult	Man	Går ej att se	-		?/b	A4
277*		Adult	Man?	Går ej att se	-		A/a	C4c
278*		Adult	Obest	Går ej att se	-		A/a	C

279*		Adult	Kvinna	Nej	38,2	148,5	A/a	C
280*		Adult	Ambiv.	Nej	-		A/a	C
281*		Adult	Kvinna	Nej	38,9	150,2	A/a	C
282*		Adult	Kvinna?	Nej	-		B/b	A4
283*		Adult	Obest	Nej	-		A/b	C
284*		Adult	Kvinna?	Nej	41,8	157,3	A/a	C
285*		Adult	Man?	Nej	-		A/a	C
286*		Adult	Kvinna	Nej	-		A/a	C
287*		Adult	Obest	Går ej att se	-			C
288*		Adult	Man?	Nej	-		A/?	A4
289*		Adult	Kvinna	Nej	-		A/a	C
290*		Adult	Man?	Nej	-		A/?	C
291*		Juvenile		Nej			A/a	C
292*		Adult	Man?	Nej			?/b	C
293*		Juvenile		Går ej att se			A/a	C
294*		Adult	Man?	Nej	-		A/b	C
296		Adult	Man?	Nej	47,2	170,7	A/a	C
297*		Adult	Kvinna?	Nej			A/a	C
298		Adult	Man?	Går ej att se	45	165,3	A/a	A4
299*		Juvenile		Nej			A/a	C
300*		Juvenile		Går ej att se			A/b	B2a
301*		Adult	Obest	Nej	-			C (B)
302*		Adult	Kvinna	Nej	-		A/a	C
304*		Adult	Obest	Går ej att se	-		A/?	B1b
306*		Adult	Man	Nej	46,4	168,7	B/b	A
307*		Adult	Man?	Nej	-		?/a	C2a
308*		Adult	Obest	Nej	-		B/b	C
309*		Adult	Man?	Nej	50,8	179,6	?/b	C
310*		Adult	Kvinna	Går ej att se	-		B/a	A4
311*		Adult	Obest	Nej	-		A/b	A4
312*		Adult	Kvinna	Nej	-		C/c	C
313*		Adult	Kvinna?	Nej	-		B/b	B2a
314*		Adult	Kvinna	Nej	42,9	160	A/a	B3
315*		Adult	Obest	Nej			?/b	A
316*		Adult	Obest	Nej	39,5	161,7	A/b	B4a
317*		Adult	Man?	Nej	42,6	159,3	A/a	C4c
318*		Adult	Man	Nej	47,9	172,4	C/c	C
319		Adult	Obest	Går ej att se	-			C
320*		Adult	Kvinna	Går ej att se	45,6	166,7	A/a	B

321*		Adult	Man?	Nej	46,1	168	B/b	C
322*		Adult	Kvinna	Nej	40,3	153,6	A/a	C1
324*		Adult	Man?	Nej	-		B/?	C4c
325*		Adult	Man	Nej	44	152,7	A/b	B3
326*		Adult	Kvinna	Nej	-		A/a	B3
327*		Adult	Man	Går ej att se	40,2	153,4	A/a	B
328*		Adult	Kvinna?	Går ej att se	-		B/b	B3
329*		Juvenile		Går ej att se			B/a	B3
330*		Juvenile		Nej			A/a	C4b
331*		Adult	Ambiv.	Går ej att se	-		A/?	C
332*		Adult	Man	Nej	44,3	156,5	B/b	C4c
333*		Adult	Kvinna?	Nej	-		A/a	C
334*		Adult	Kvinna	Ja	-		?/a	C4a
335		Adult	Obest	Går ej att se	-		?/a	C
336*		Adult	Kvinna	Nej	-		A/b	B3
337*		Adult	Kvinna?	Nej	43,2	160,8	A/a	B2a
338*		Adult	Man	Nej	42,9	160	B/b	C
339*		Adult	Kvinna?	Nej	-			C
340*		Adult	Kvinna	Går ej att se	-		B/b	C
341*		Adult	Kvinna?	Nej	42,3	158,6	C/c	C
342		Adult	Obest	Går ej att se	-			C
343*		Juvenile		Går ej att se			A/a	C
344*		Adult	Man	Går ej att se	46,3	168,5	A/b	A4
345*		Juvenile		Går ej att se			A/?	B
346*		Adult	Kvinna	Nej	-		A/a	C
347*		Adult	Obest	Går ej att se	-		B/b	C
348*		Adult	Kvinna?	Går ej att se	-		B/b	B4b
349*		Juvenile		Går ej att se			D/?	A
350*		Adult	Kvinna?	Går ej att se	-		A/a	B4b
351*		Juvenile		Nej				C
352*		Adult	Kvinna	Går ej att se	42,5	159,1	B/b	C
353*		Juvenile		Går ej att se			D/?	C
354*		Adult	Kvinna?	Nej	47,5	171,4	A/b	C
355*		Adult	Kvinna	Går ej att se	-			C
356		Juvenile		Går ej att se				B
357		Juvenile		Går ej att se			?/a	B
358		Adult	Obest	Går ej att se	-		?/d	C
359*		Adult	Obest	Nej	-		B/b	C
360*		Adult	Man	Går ej att se	-		B/b	C
361*		Adult	Obest	Går ej att se	-		B/b	C3

362*		Adult	Man	Nej			C/d	C
363		Adult	Man?	Nej	47	170,2	B/a	C
364*		Adult	Kvinna	Nej	40,4	153,9	A/a	C1
365*		Adult	Man	Nej	-		B/b	C2a
366*		Juvenile		Nej			C/c	C
367*		Adult	Kvinna?	Nej	-		A/a	C
368*		Adult	Kvinna	Nej			A/b	B4a
369*		Adult	Obest	Går ej att se	-		B/a	C
370*		Adult	Kvinna?	Går ej att se	42,7	159,6	A/a	C2b
371*		Adult	Obest	Nej	-		B/b	C4a
372*		Adult	Kvinna?	Går ej att se	42,1	158,1	B/b	C
373*		Adult	Kvinna	Nej	41,9	157,6	A/?	C4c
374*		Adult	Kvinna?	Nej	-		B/b	C
375*		Adult	Obest	Går ej att se	40,6	154,4	B/a	C
376*		Adult	Obest	Går ej att se	-			C4c
377		Adult	Kvinna	Går ej att se	-		A/a	C4c
378*		Adult	Kvinna	Går ej att se	41,4	156,4	B/b	C
379		Adult	Obest	Går ej att se	-		B/b	C
380*		Juvenile		Nej			A/a	B2a
381*		Juvenile		Nej			B/c	C
382*		Adult	Kvinna?	Nej	-		B/a	C
383		Juvenile		Går ej att se			B3	
384*		Adult	Obest	Går ej att se	-		B/b	C
385*		Juvenile		Nej			?/a	C
386*		Adult	Obest	Går ej att se	-		A/a	A2
387*		Juvenile		Går ej att se			A/a	B1b
388*		Juvenile		Nej			A/a	B1b
389		Adult	Obest	Går ej att se	-			A2
401		Adult	Obest	Nej	-			A
402*		Juvenile		Nej			D/d	C
403		Adult	Obest	Går ej att se	-		-	A
404		Adult	Obest	Går ej att se	-			C
405		Adult	Obest	Går ej att se	-			C
406		Adult	Obest	Går ej att se	-			C
407		Adult	Obest	Går ej att se	-			C
408		Adult	Obest	Går ej att se	-			C
409*		Adult	Obest	Går ej att se	-		B/?	A
410*		Adult	Man?	Nej	-		B/b	C
411		?	Obest	Går ej att se	-			C

412*		Adult	Man?	Går ej att se	48,6	174,1	D/d	C
413		?	Obest	Går ej att se	-		D/?	C
414*	a	Juvenile		Går ej att se				C
414*	b	Juvenile		Nej				C
415*		Adult	Kvinna?	Går ej att se	-			C
416		Adult	Obest	Går ej att se	-		?/b	C
417*		Adult	Obest	Går ej att se	-		A/a	C
418		?	Obest	Går ej att se	-			A
420*		Adult	Obest	Går ej att se	-		D/d	C
421		Adult	Kvinna?	Nej	-		B/b	C
422*		Adult	Obest	Går ej att se	-		B/b	C
423		Adult	Obest	Går ej att se	-		A/?	A
424		?	Obest	Går ej att se	-			C
425		Adult	Obest	Går ej att se	-			C
426		Juvenile		Nej				C
427*		Juvenile		Går ej att se			C/d	C
428*		Adult	Obest	Går ej att se	-			C
429*		Adult	Kvinna?	Nej	-		B/b	A
430		Adult	Obest	Går ej att se	-			C
431		Adult	Obest	Går ej att se	-			C
432*		Adult	Kvinna?	Går ej att se	-			C
433*		Adult	Obest	Går ej att se	-		B/b	C
434		Adult	Obest	Nej	-		A/?	C
435		?	Obest	Går ej att se	-			A
436		Adult	Obest	Går ej att se	-			C
437*		Adult	Kvinna?	Nej	-			C
438*	a	Juvenile		Nej			C/c	C
439		Adult	Obest	Går ej att se	-			C
440		Adult	Obest	Går ej att se	-			C
441		Adult	Obest	Går ej att se	-			A