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A SCRUTINY OF OSTEOLOGICAL ANALYSES OF MEDIEVAL POPULATIONS IN RURAL FLANDERS (BELGIUM), IN COMPARISON WITH NORTH-WESTERN EUROPEAN CASE STUDEIS, BASED ON THE OSTEOLOGICAL ANALYSIS OF THE SKELETAL REMAINS FROM MOORSEL & OOSTERWEEL

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Abstract: Two osteological analyses, one of 103 individuals from the rural medieval graveyard in Moorsel, and one of 68 individuals from Oosterweel (both located in Belgium), were the start of a comprehensive study regarding rural medieval populations in north-west Europe.

Despite a hiatus in the osteological research of both rural populations and those with a lower social status in most north-western European countries addressed in this study, palaeopathological data implied a higher frequency in (healed) trauma and musculoskeletal stress markers (MSM) for both sexes, plausibly due to heavier physical labour, and fewer infectious and deficiency diseases compared to the urban, and especially to the industrialised, environment. Moreover, palaeodemographic data suggested an equal ratio between male and female inhumations compared to skeletal remains excavated inside a church with a 2:1 male preponderance.

Besides a similar average stature (with a slightly higher result for rural females), the macroscopic investigation suggested a general good health condition which was also attested in the selected rural case studies.

However, taking into consideration the osteological paradox, we suggest biomolecular analyses for further investigation concerning infectious diseases.

Keywords: rural, osteological analysis, medieval, MSM, palaeopathology, palaeodemography, Moorsel.

Introduction

Over the past few years, there has been a growing interest in the macroscopic study of human bones. This interdisciplinary approach, also known as human osteology, aims to establish a reconstruction of an ancient population by the implementation of palaeodemographic and pathological data, such as the determination of age at death, sex, stature, and health status of an individual (Ervynck *et al.* 2012). Moreover, it also offers us a valuable complement to the historical, social and economic condition of a human being from a past community (Meier and Graham-Campbell 2007).

The goal of this scrutiny is to shed light on the health status of a medieval rural community and/or individuals from both the Low Countries and north-west Europe, primarily based on the osteological analysis of 103 skeletal remains from Moorsel in Belgium. Osteological data regarding 68 individuals from Oosterweel are integrated in Table 2 below. For a more comprehensive analysis of this site, please contact the author of the article.

During 2009 and 2010, excavations executed by SOLVA took place in this rural village in order to gain more insight in the evolution of this settlement. Besides the uncovering of the sacral area between the Saint-Gudula chapel and the Saint-Martin church, the human bones of 103 individuals were exposed, and have never been subjected before to a profound bioarchaeological examination (SOLVA 2011).

To broaden our understanding regarding the geographical, historical, socio-economic and demographic background of Moorsel, a critical approach to the existing literature about this rural village and its surroundings was executed. An over view of that analysis follows below. The osteological analysis of the 103 skeletal individuals focused on the determination of palaeodemographic data such as sex, age at death, stature, pathological and dental analysis, and finally musculoskeletal stress markers (MSM). Lastly, twelve case studies from north-west

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Europe were selected in order to establish a comparative analysis. This study relied on existing osteological reports regarding skeletal collections from mainly rural communities with a lower social status, however, if we want to outline the health status of rural populations, we cannot neglect the urban environment. Therefore, one case study from a lower class urban population was selected to emphasise any similarities and/or discrepancies.

Restrictions to this research

Being a recent discipline, human osteological analyses of rural skeletal populations are consequently rare, especially those with a lower social status as most human remains are excavated within monasteries and churches of a rural and principally urban context, and hence imply a higher social class (Ervynck *et al*. 2012). Because of this restriction, reports concerning high status individuals were consulted; nevertheless, the results irrefutably represent a rural community.

The use of a universal methodology needs to be encouraged as different approaches in each European country towards both human osteology and the application of bioarchaeological methods plausibly influence the final results of each study. In the end, since many of these osteological approaches are new, we would like to emphasise the pivotal significance of a continuous acquisition of both theoretical and practical knowledge.

The evolution of rural Moorsel

Moorsel (Figure 1) is situated in the east of the province East Flanders in Belgium. Given its location in a transitional alluvial area, its sandy loam soil is particularly appropriate for agrarian activities (Pieters 1986: 42; Wille 1985: 22).

Verbesselt (1967: 141 and 145) referred to the suffix *zele* as an attestation of cultivation in the fourth and fifth century AD, and which might indicate a villa or an agricultural organisation. Archaeological research by Pieters (1986: 42-43) included finds such as *tegulae* and pottery, and demonstrated most likely a Gallo-Roman presence.

Furthermore, Verleyen (1985: 220) stipulated that the fourteen *kouter*-toponyms in Moorsel like for instance *Molenkouter* and

Figure 1 Location of Moorsel in Belgium after Callebaut 1979: 5, nr. 1.

Rozenkouter originated in the Roman era, and hence represent the organisation of the arable land (Figure 2).

Since the second half of the fourteenth century, agricultural activities consisted of the cultivation of wheat, oat, rye, and hops (Verleyen 1985: 222). Four centuries later, the weaving industry became a crucial economic importance in the region by which post-medieval artefacts such as spindle whorls, uncovered from a field in Moorsel, might be an indication for the activities of the inhabitants (Pieters *et al*. 1986: 51; Schelstraete *et al*. 1986: 47).

Demographic data from parish registers in Moorsel between 1605 AD and 1797 AD have been compiled by Aelbrecht (2006), and revealed a total of 5653 family units residing in the village in nearly two hundred years. According to Verleyen (1985) population movement most likely occurred between 1630 AD and 1800 AD. In spite of a population surplus each decennium, the population in 1630 AD was *ca*. 830 and only increased to *ca*. 2280 in 1800 AD. However, Thoen (1988: 186) stressed the impediments of migration data while studying 'a dynamic source as parish registers' in his doctoral research about medieval agricultural economics and demographic evolution in Flanders.

Additionally, because of the plague in 1667, a high mortality rate was recorded and caused a large number of deaths in a short time span (Verleyen 1985: 147, 205 and 379). However, bacterial infectious diseases like the Black Death are unfortunately not macroscopically identifiable on human bones as they solely

Figure 2 This reconstructed map based on land books from 1636 and 1637 shows various toponyms like Den Bruggen Cauter, Het Boony Velt and Den Auwerodt, all referring to the cultivation of farmlands (Image from Aelbrecht 2006, s.f.).

affect the soft tissue (Aufderheide and Rodríguez-Martin 2008: 195-198). Roberts and Manchester (2010: 13) also stated that if an acute infective disease occurs, no bone modification would manifest on the skeleton because the individual had passed away before the development of bone alteration. To gain more insight regarding pandemics and mortality rates, the application of biomolecular methods is for this purpose suggested by the biological anthropologist Dominique Castex (2010: 41). Excavations by SOLVA (2011) around the church indicated a long period of intense burials noticed in the intercutting of the graves and the intrusive bone material, suggesting an actual higher amount of skeletal individuals (Figure 3).

Past archaeological projects in Moorsel: a brief overview

Since 1975, various excavations have been attesting the archaeological value of Moorsel. Besides the uncovering of a *motte* or a military fortification from the first half of the twelfth century AD, further research was principally situated at the village square between the Saint-Gudula chapel and the Saint-Martin church (Callebaut 1979: 6 and 32; Pieters *et al.* 1999: 137-142). Hagiographic sources as *Vita Gudula* and *Vita Berlindis* refer to the possible existence of an early medieval monastery in the seventh century AD in this area; however, this has not been archaeologically attested (Figure 4).

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Figure 3 The intercutting of this post-medieval grave indicates an intensive usage of the burial ground around the Saint-Martin church (Photo by SOLVA, Rapport 12: 33, nr. 17).

Indeed, rescue excavations in 1987 and 2007 could not determine this presumed religious convent despite the uncovering of four postholes and the remains of a circular kiln. These finds have been cautiously linked to the monastery by the researchers, however, dating analysis within the sacral area around the chapel revealed the tenth century AD (De Groote and Moens 2008: 83-84; Pieters *et a*l. 1999: 131-132, 152 and 154).

Figure 4 The village square (here pictured in 1943, Photog. unknown) with the Saint-Gudula chapel (left) and the Saint-Martin church (right). The hypothetical existence of an early medieval monastery is not yet archaeologically attested (Dierickx 1988: 56).

In 2009 and 2010, further research in the same area was executed by SOLVA. A reorientation of the churchyard was uncovered that included the repositioning of the entranceway to the current street between the chapel and the church.

The investigation also exposed medieval structures seen in the circular moats, and revealed a dualism between the church and the chapel from the tenth century AD. However, a definite affiliation could not be identified, and hence a potential autonomous function of both organisations is suggested by the investigators (SOLVA 2011).

This dualism is also discernible in the burials located around both the church and the chapel, of which the skeletal remains are the focus of this study. On the one hand, a smaller medieval cluster of interments is situated around both the chapel and the church, whereas on the other hand, a more extensive post-medieval group of inhumations was solely buried around the church. Furthermore, three burial types from the medieval group have been distinguished: anthropomorfic, coffins, and one most likely tree trunk coffin (Figure 5). Contrarily, all inhumations from the post-medieval cohort possibly involved solely coffin burials, albeit a precise grave lining could not be registered for each individual (SOLVA 2011, Rapport 12: 19-26, 30 and 34).

More discrepancies between the medieval and post-medieval inhumations were ascertained in the grave alignment and position of the arms of the skeletal individuals. With a west-east alignment as the most common position for the anthropomorphic graves, and with their arms extended, a contrast was noticed with those from the post-medieval cluster. Here, various deviant orientations such as southwest-northeast were noticed, and the arms were crossed over the pelvis or the chest. Artefacts were principally discovered within the post-medieval burials, and included Christian related ornaments such as crosses and jewellery (Figure 6). The only medieval goods were a coat pin made from bone and a fibula.

Finally, carbon dating was applied on selected inhumations from both cohorts, and revealed a date in the range cal. AD 501-1923, the latter year in which the churchyard ceased to exist and relocated to a new burial ground outside Moorsel (SOLVA, Rapport 12: 19-35).

Figure 5 A possible tree trunk coffin was uncovered, together with a tegula fragment underneath the head. A date in the range cal. AD 780-990 was revealed '(calibrated date)' (KIA-44330). (Photo by SOLVA, Rapport 12: 24, nr. 10.).

Figure 6 The arms of this post-medieval inhumation were found crossed over the pelvis. Also common for Christian burial rites are ornaments with a Christian connotation. Here two rosaries were buried with the deceased. (Photo by SOLVA, Rapport 12: 36, nr. 20).

The osteological analysis of the 103 skeletal individuals from Moorsel

All skeletal individuals were excavated and inventoried in 2009 and 2010 by SOLVA, and were mainly uncovered in an anatomical position. The presence of intrusive bone material was suggestive an original higher minimum number of individuals (MNI). This study does not include the osteological analysis of the intrusive bones.

A pivotal aspect of human bone studies is the degree of completeness and the quality of preservation of the skeletal remains (Vander Ginst and Vandenbruaene 2006: 136-137). Taphonomic processes like soil and climate conditions, but also post-mortem processes like scavenging, post-depositional disturbance, treatment after excavation, and even the age of the deceased may influence the quality and quantity of the human bones (Mays 2010: 28-29; Smits 2002: 55).

Assessment of the macroscopically observable surface preservation of the human remains in this research was done by applying a grading system from 0 until 5+, with 0 indicating a clearly visible surface morphology and no modifications, and a score of 5+ implying heavy erosion masking the whole bone surface and a modifying profile (Brickley and McKinley 2004: 16).

Fifty percent of the skeletal individuals addressed in this study were in a good qualitative condition. The quantitative condition, however, was more inferior as no skeleton was 100 percent complete. To record missing and present bone elements, ten categories were made representing the following skeletal zones: CA (skull), FA (face), MB (mandibula), CV (spine or vertebra), TH (ribs and sternum), PE (pelvis), MS (upper limbs), OM (hands), MI (lower limbs) and OP (feet). When a single bone element from one skeletal zone was detected, the related skeletal zone was registered as present.

Methodology

All 103 skeletons were laid out in an anatomical position followed by an analysis according to the standards of both the British Association for Biological Anthropology and Osteoarchaeology (BABAO), and Maat and Mastwijk (Brickley and McKinley 2004: 7-47; Maat and Mastwijk 2009: 2-47). In Belgium, the value of osteological analysis of human skeletal remains and its recent development has been emphasized by the implementation of a new standardized, uniform methodology in 2012 by the Flanders Heritage Agency (Agentschap Onroerend Erfgoed) (Quintelier *et al.* 2012: 263). This 'method statement for macroscopic morphological and metric study of unburnt human remains' will enhance the quality of future publications and is based on current knowledge within this discipline. In

this respect, modifications of these regulations, according to the personal emphasis of the researcher, will be taken into consideration as this discipline is undergoing a continuous methodological development (Quintelier *et al.* 2012: 263 and 271)

To record the determination of age at death, sex, stature, pathological and dental analysis, MSM and the completeness and quality, standardized forms were used and all obtained information was archived in a newly designed data sheet for each skeletal individual.

N.B. All skeletal data sheets by the author are available upon request.

Determination of sex, age, and stature

The estimation of the sex of an adult is less complicated compared to the sex of a juvenile as the bones of the former are fully developed (Roberts 2009: 124). Sex assessment of males and females is accomplished by observing morphological traits on both the skull and the pelvis, giving priority to the latter (Mays 2010: 40).

Assessment of age was done by using the following methods: the symphyseal phase of the pubic symphysis, the stage of the auricular surface, the sternal ends of ribs, the obliteration stage of the endocranial and ectocranial sutures, and through occlusal dental wear. Using dental wear as an ageing method implies a few possible limitations as Mays (2010: 73) argued that individuals in an archaeological group all experienced similar rates of wear. However, a previous investigation on Paraguayan Indians using this technique elucidated its efficiency, and therefore the Miles method could be considered as a possible estimation of age (Mays 2010: 74). Also, Mays (2002: 869) suggested that post-medieval skeletons demonstrate less attrition, but admitted that certain European populations continued to display heavy dental wear during the same era. While this method does not provide a decisive answer, it could be regarded as an indicator when compared with other ageing techniques.

Furthermore, to determine the age of sub-adults, both the ossification of the axial skeleton and the epiphyseal fusions with the diaphyses of the long bones were used. To define the stature of the individuals the following three methods were combined: the measurements of the present complete long bones of the lower and upper extremities, followed by the application of the tables by Trotter (1970) for males, and Trotter and Gleser (1958) for females. As these equations are derived from American samples, they might not be applicable for British or European estimations of stature; the method of Breitinger (1937) for adult males by measuring the parallel length was additionally applied as a control. All measurements were registered with a standard deviation. Lastly, we also used the bicondylar length of the femur/stature formula by Feldesman *et al.* (1990).

Pathological Analysis

Palaeopathology represents the study of diseases in past populations, and thus the skeletal remains of an individual are the primary source to investigate the health status. However, unlike chronic conditions, acute diseases, which principally affect the soft tissues, do not manifest on the skeleton (Aufderheide and Rodríguez-Martin 2008: 118; Roberts and Manchester 2010: 13; Waldron 2009: 1-5).

To record pathological lesions on the skeleton, a classification of diseases and injuries was formulated according their aetiology, and consists of the following diseases: trauma, joint disease, infectious disease, metabolic disease, hematologic disease, and neoplastic disease (Roberts and Manchester 2010: 21).

Dental Health

All present mandibular and maxillary dental elements were examined and the cause of the missing elements described: post-mortem lost (PM), ante-mortem lost (AM), missing (M), unerupted (U) or congenitally absent (C). Determination of the occlusal surface wear was recorded by a grading system by Smith (1984: 39-56) to score each tooth from 1 (no dentin exposure) to 8 (severe dental wear affecting whole crown), and by Brothwell (1981: 176). Finally, the stage of periodontitis, calculus and alveolar atrophy, and identified caries, enamel hypoplasia, discoloration and tooth abscesses were investigated.

Musculoskeletal Stress Markers (MSM)

The study of musculoskeletal stress markers (MSM) aims to reconstruct the physical activity of an individual. When a muscle joint endures a severe repetitive pattern of stress, it is suggested this is caused by a specific occupation or activity. To reconstruct this activity, musculoskeletal markers as enthesophytes are applied. Situated at tendon

and ligament insertions they might imply an intense use of certain muscles when new bone formation at the site of a muscle attachment occurs (Roberts and Manchester 2010: 143-147).

To record these musculoskeletal stress markers, a method after Hawkey and Merbs (1995) to score robusticity (swelling, ridging or cresting of bone at attachment site), cortical defect (pit-or furrow-like depression of bone cortex) and ossification exostosis (bony spur at ligament attachment site) of seven muscle attachment sites observed in the upper limb was applied. For the determination of the ossification exostosis of the *biceps brachii* insertion on the radius, the scoring system by Villotte (2006: 72) was utilized.

Finally, we observed and recorded the grade of robusticity, exostosis, or hypertrophy of muscle attachment sites on the lower limbs. Nevertheless the study of MSM is a recent scientific approach; we must bear in mind each individual reacts differently when executing strong physical activity and we certainly have to be careful with stereotyped and ethnocentrically biased interpretations. (*Pers. comm*. Sirpa Niinimäki 2011).

Discussion of the osteological analysis

The osteological analysis of 103 rural early medieval to post-medieval skeletal remains from the churchyard in Moorsel provided distinct results about the composition and health status of an agrarian community. However, this sample only represents a small fraction of the entire population since influential aspects like the excavated area, post-depositional processes, burial rites as well as the applied methodology will eventually define the complete skeletal collection.

For instance, the low frequency of only six juveniles was remarkable. The data therefore suggest that most sub-adults were buried in a specific location either within the graveyard, or within the church. The latter was attested in the O.L.V. cathedral in Antwerp where a cluster of child inhumations near the chancel was uncovered during previous excavations (Bungeneers 1987: 6).

Besides these six sub-adults, sex could not be determined for 34 individuals. On the other hand, 36 males and 27 females were clearly determined (Figure 7). Compared to parishes and monastic communities where skeletal remains were excavated inside the church, the male: female ratio implied 2:1 in all cases, indicating a definite male supremacy (Vander Ginst and Vandenbruaene 2006: 145). The sample population, however, revealed a more equal ratio between both sexes, regardless of the undetermined individuals. Moreover, even historical sources referred to this gender equilibrium, as Thoen (1988: 103) posited 'there was during the Middle Ages neither a surplus nor a shortage of women in this region'.

88 skeletal individuals were aged, with most deaths occurring in the age range 21-39 years followed by the category older than 40 years. Examining the distribution according to sex (Figure 8), we notice a clear difference between the male and female cohort, with the highest frequency for female deaths between 21 and 39 years, and for males in the age group older than 40 years. Interpretations for this age at death discrepancy may lie in the suggestion that women were more susceptible to bacterial infections, or that they endured complications during pregnancies, which implied a higher risk of death (De Groote *et al.* 2011: 169; Thoen 1988: 103).

Metric analysis of 29 males, 24 females, and 11 undetermined individuals revealed an average stature of respectively 169 cm (M), 161.8 cm (F), and 169 cm with the height estimated between 161 cm and 177 cm for the undefined group (Figure 9). De Groote *et al.* (2011: 172) stated that the average stature is representative for both the health status and socio-economic condition of an individual and community. The comparative analysis in this study below will elucidate whether or not this axiom corresponds with the other rural case studies.

Pathological analysis revealed a high frequency in degenerative disc diseases, osteoarthritis and healed trauma (Table 1). The first two diseases were seen in both sexes, and have a correlation with age, the latter predominantly observed in the male segment (Figure 10). Infectious diseases, on the other hand, were not very common, although they are not always macroscopically identifiable on human remains since they manifest before bone alteration occurs (De Groote *et al.* 2011: 177).

Dental pathology also demonstrated a correlation with age regarding caries (10%) and ante-mortem tooth loss (17.6 %). Hillson (1996: 269-280) argued that ante-mortem tooth loss is caused by periodontal diseases and permanent caries. Hence, the actual

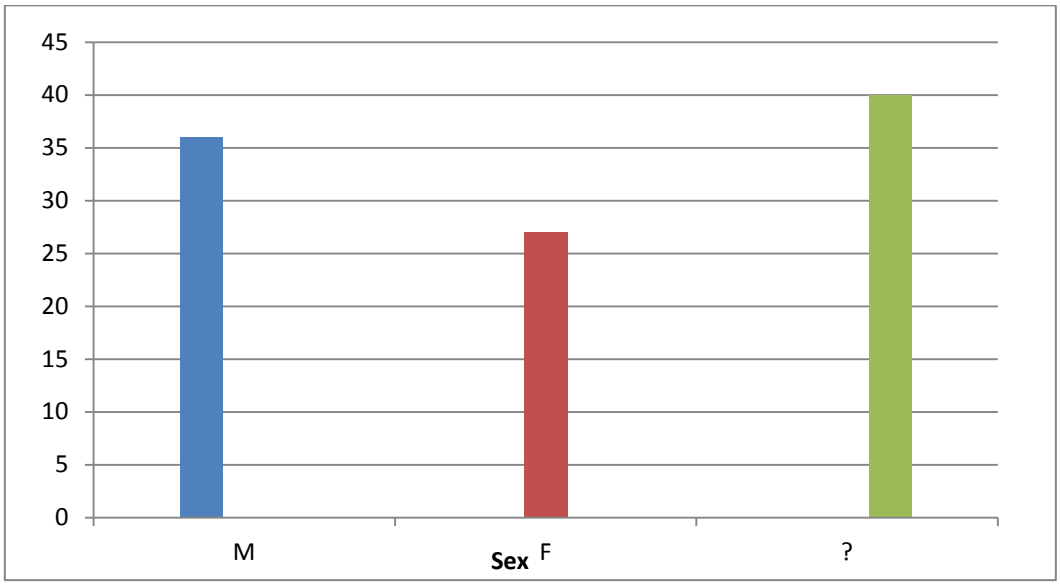

Figure 7 Distribution of sex

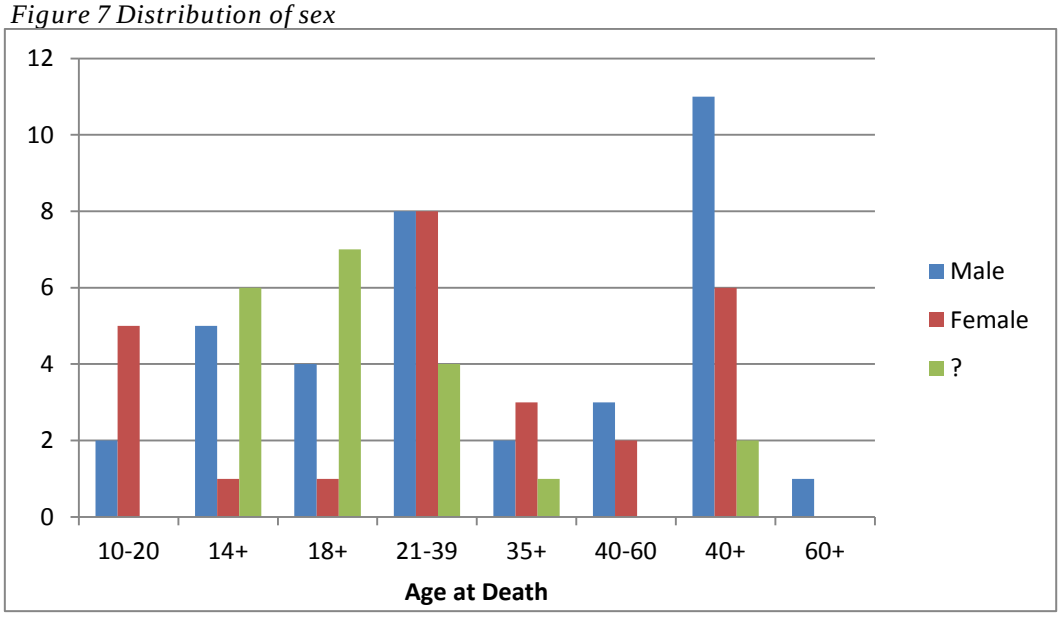

Figure 8 Distribution of age at death in correlation with sex

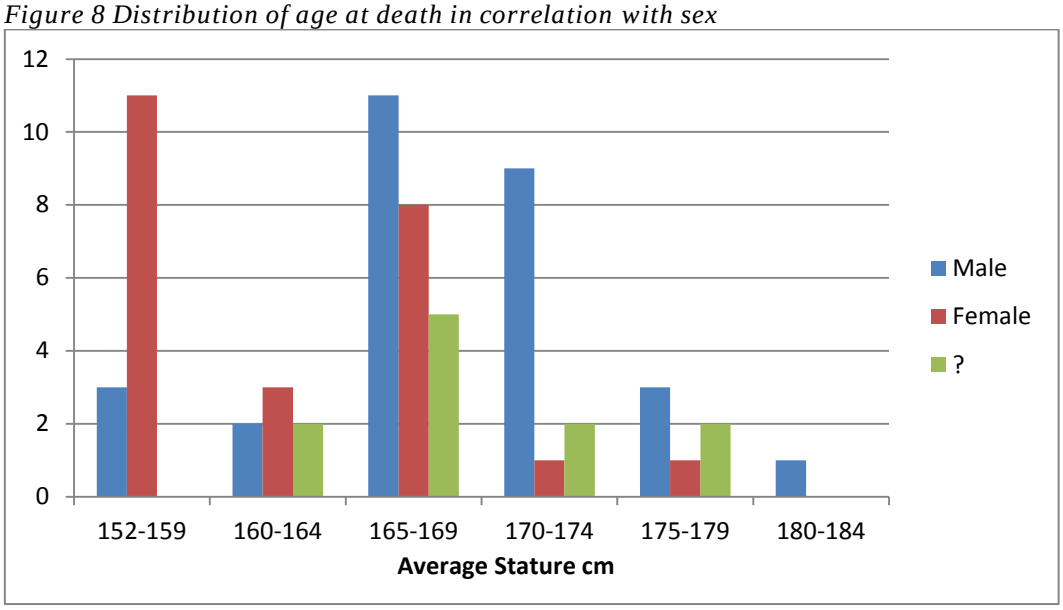

Figure 9 Distribution of average stature in correlation with sex

Pathology	Males	Females	?	Total
DDD	18	5	3	26
Schmörls Noduli	7	1	2	10
pOA	1	2	-	3
vOA	7	3	-	10
RA	11	9	-	20
DISH	1	-	-	1
Ankyl. Spond.	4	2	-	6
Sacro-iliac joint infl.	6	4	-	10
Traumata	12	2	1	15
Periostitis	3	2	1	6
Osteomyelitis	1	-	-	1
Rachitis	1	-	-	1
Osteoma	-	1	-	1
Cribra Orbitalia	-	1	-	1

Table 1 Overview of the most frequently observed pathologies

attestation of caries must have been higher within our community. Nutrition has a strong impact on the dental health of a human as for example the intake of carbohydrates influence the frequency of caries. For this reason, the import of cane sugar in the post-medieval society caused a severe increase (Polet 2010: 65-66).

Figure 10 This 30 to 45 yr old male (above, SOLVA, Picture database, nr. 317.) displayed a healed trauma on the distal end of the right femur (detail below) (Photo by author)

Despite the high frequencies of caries and ante-mortem tooth loss, a low quantity of enamel hypoplasia was observed: only five individuals between seven and 50+ years old showed this stress lesion (Figure 11). This degradation of dental enamel is caused by a nutritional deficiency, and is indicated by horizontal and parallel lines on the teeth (Polet 2010: 66). Furthermore, Polet (2010: 66) assumed that a higher social status correlates to the development of enamel hypoplasia with thus a higher frequency in lower classes.

Figure 11 The remaining teeth of this maxillary fragment from a juvenile between 7 and 10 years old demonstrate enamel hypoplasia (Photo by author).

However, Polet referred to one singular study. Further research within the nearby post-medieval monastic community by Degroote *et al.* (2011: 188) revealed the antithesis since

this higher class community was observed with an extensive amount of enamel hypoplasia. Therefore, further research regarding its aetiology is required.

The study of musculoskeletal stress markers (MSM) uncovered significant divergences between both sexes. For instance, within the male group, a high frequency of stress in the shoulder was recorded, particularly at the tendon of the *musculus teres major* of the right *humerus*, which implies retroflection and adduction movements of the upper arm (Figure 12). The female section, to the contrary, showed a strong augmentation of hypertrophy or bone ossification on both *femora* or thigh bones, as well as robusticity at the tendon of the *musculus deltoideus* of the *humerus* (Figure 13). This would suggest respectively long lasting, heavily walking and moving the arm upward and downward. The latter could be an association with the weaving industry or other rural activities as milking cows, although it is best to be cautious with gender biased interpretations.

Figure 12 Fragment of the diaphysis of the right humerus of a man between 40 and 70 years old showing a cortical defect stage 3 at the tendon of the musculus teres major *suggesting retroflection and adduction movements (Photo by author).*

Figure 13 Fragment of the right humerus with robusticity stage 3 of the tuberositas deltoidea *(lateral view) of a woman with a minimum age of 14 years old (Photo by author).*

A previous osteological analysis by the author of a (post)medieval rural population of high status individuals from Oosterweel (province of Antwerp, Belgium) elucidated that no MSM was observed within the female cohort (Van Cant 2011) There is therefore a possibly notable distinction in the performance of labour between these two female social classes.

To summarize, this palaeodemographic and pathological analysis of a small rural community revealed an equal ratio between male and female burials, a higher frequency of osteoarthritis, healed trauma and degenerative disc diseases in comparison with (macroscopically detectable) infectious diseases, and a discrepancy regarding MSM both on inter-population and intra-population level. This analysis will hopefully be complementary to the hiatus concerning the research of rural skeletal remains, and will stimulate future investigation.

Comparative analysis: case studies from north-west Europe

In order to define a correlation with other medieval populations in north-west Europe, the study relied on the osteological analyses of mainly rural skeletal remains that were excavated in the Low Countries (Belgium and the Netherlands), north-west France, north-west Germany and the United Kingdom (Table 2). Therefore most pivotal palaeodemographic and pathological data was collected to identify any similarities or discrepancies compared with the examined sample populations. Restrictions, however, were observed in the applied methodology (Germany and UK), and in the accessibility to the osteological reports (France).

Due to the modernity of human osteology as a discipline, most skeletal remains from north-west Europe were also excavated within an urban environment or churches and monasteries, and hence implying a different social status. To show the impact of the industrialization on the health status of lower class individuals, the reference sample of s-Hertogenbosch in the Netherlands was compared, in which overpopulation, famine and various bacterial infections were reflected in the shorter stature of the inhabitants.

Similarities were further observed in the equal male: female ratio for rural inhumations in contrast to those buried inside a church. Only the agrarian community of Poulton (UK) showed a female supremacy, but this is

possibly due to a restricted applied methodology regarding the determination of sex.

If the stature counts indeed as an indicator for health and socio-economic conditions, the study sample irrefutably displayed a higher average stature compared to an urban environment with inferior living conditions, but a more or less similar height to higher social status individuals. Moreover, a noteworthy higher female stature was seen in Moorsel, Raunds Furnells (UK), and in the Netherlands.

Age at death only indicated a resemblance between the Netherlands and Germany, and is considerably lower for all Belgian case studies. Limited access to health care is likely the main reason for a shorter life span for females with a lower status; otherwise the size of the skeletal sample and the utilized methodology for age determination in the Netherlands and Germany might influence the conclusions.

Furthermore, all rural case studies revealed a higher frequency of degenerative disc diseases, osteoarthritis, trauma, and MSM, and fewer bacterial infectious diseases in contrast to an urban (and even more industrialised) environment because of the overpopulation and poor living circumstances of the latter.

	Site	N		Age		Stature (cm)		Caries	AM	Era
		M	F	M	F	M	F	Index (%)		
Belgium (East-Fland.)	**This study**	36	27	39.4	31.3	169	161.8	10	17.6	Early medieval-1923
	Aalst (monastery)	125	63	39.9	35.7	170	160	10	19	1497-1797
	Hofstade (church)	6	1	-	45+	166	-	13	45	800 – 1799
	Meldert (idem)	9	3	34	34	171.5	161	3	10	Post-medieval
	Oosterweel (idem)	30	14	37.5	34.5	169.6	161.1	11	9	Late (post) medieval
The Netherl.	**Elst**[1]	61	47	47	38	173	162	12	40	1525-1850
	Delft Early	27	17	43	47	171	164.4	7.6	16.2	1265-1433
	Late	21	24	43	49	170	162,2	12,3	19.1	1433-1652
	s-Hertogenbosch	123	114	43.4	41.4	169.6	160.5	21	16.5	1830-1858
UK	**Poulton**[2]	53	83	26-45		171	160	-	-	1000-1153
	Raunds Furnells[3]	100	82	45+	17-25	167	162	Low	High w. 45+	900-1199
France (NW)	**Tournedos**	-	-	-	-	-	-	-	-	650-1399
	Saleux	Equal		-	-	-	-	High	-	600-1099
Germany (NW)	**Osnabrück-Schölerberg**[4]	13	7	33.3 (47.5)	33.3 (46)	172	159	Low	-	700-850

Table 2 Overview of the most significant palaeodemographic skeletal data of the twelve case studies in north-west Europe.

[1] Caries and ante-mortem tooth loss are in the research of Elst only determined through molar teeth.

[2] Since we do not possess any detailed information about the precise age at death, we hereby include the age group with the highest number of deaths recorded.

[3] *Idem.*

[4] The determined age in this case study is the expected age at death for males and females. As we were able to consult the age at death of eleven males and six females in the osteological report, we therefore could estimate their average age at death (listed between brackets).

Conclusions, questions, and recommendations for future work

Despite the observation of strenuous physical activities as noticed in the upper limbs of this study sample, the health status of rural medieval populations in north-west Europe was not particularly inferior to that of more urban populations. Nonetheless, not every infectious disease is macroscopically detectable. Also, various factors such as skeletal sample size, applied methodology, the expertise of the human osteologist, and both the completeness and the quality of the human bones of the selected populations might all have an influence on the obtained data.

Given the results of this study, the following questions will be valuable for further consideration:

1) What can we learn about the rural health status on both inter-population and intra-population level?

2) Could an implementation of biomolecular methods as aDNA add new perspectives regarding the health status of rural communities?

3) If we could collect more osteological data regarding these communities, could we

- consequently gain more insight concerning the impact of commercialisation of labour on the health of an individual and/or community?
- And could we shed light on the role of rural labour supply as Thoen (2001: 142) puts forward the continuous debate about its function in the developing industrialisation of towns?

Human osteology, and specifically those studies concerning rural populations, is a modern scientific discipline in north-west Europe, which is definitely in need of a clear and universal standardized methodology and inventory in order to obtain a comprehensible reconstruction of the life and health of past populations. This study will hopefully add to the growing corpora of methodological approaches and provoke further discussion regarding the necessary growth within the discipline.

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