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HUMAN REMAINS FROM THE INFIRMARY "OUDE EN NIEUWE GASTHUIS" OF THE CITY OF DELFT IN THE NETHERLANDS (1265-1652 AD)

Onisto, N.[2], Maat, G.J.R.[1] and E.J. Bult[3]

[1]Centre for Physical Anthropology, Medical faculty, Leiden University.
[2]Department of Biology, Padua University, Italy.
[3]Department of Development and Housing, section of Monuments and Archaeology of the City of Delft.

ARCHAEOLOGICAL and HISTORICAL INTRODUCTION

During rescue-excavations of 1985-1987 and 1993 at the "Gasthuis-plaats" in the City of Delft, remains of its oldest medieval infirmary were found. The structures were interpreted as the foundations of a chapel, an infirmary, cesspits, some wooden outbuildings and a cemetery. A general survey on the layout of the site was published previously (Kistemaker et al., 1985; Kistemaker, 1990; Bult, 1995). It should be mentioned, that at that time, interpretations were hampered by the incompleteness of the excavation. Coming rescue-excavations will be of assistence in the near future.

The presence of a medieval cemetery provided a unique opportunity to study how a Dutch medieval city affects the life of its citizens. During the 13th-16th century major transitions occurred in the City of Delft. In 1246 AD, Count Willem II of Holland granted Delft the privileges accorded to a town (Niermeyer, 1944). In the formative period of town development, 13th-14th century, Delft still resembled an agrarian village with wooden houses, the presence of live-stock, and crafts and trade mainly based on agrarian products. Its central location to the agrarian producers reflected the primary function of Delft as a local and regional market place. The number of people living in the settlement during this formative period in the middle of the 13th century is estimated to be about 500 inhabitants.

During the 14th century Delft changed into a fully developed town with brick houses, specialized crafts such as beer production, and the making of cloth, and inter-regional trade. The city increased substantionally. From the beginning of the 15th century onward the population in Delft grew from 6,500 inhabitants to about 30,000 by the middle of the 16th century (Ramaer, 1921; Kok, 1979). This rapid growth prompted the local government to make adjustments in order to prevent overcrowding and environmental pollution, to maintain and stimulate the facilities for crafts and export, and to reduce unemployment. These adjustments included requiring that citizens throw dirt into cesspits instead of throwing it into the canals, since the water in the canals was used for brewing beer. Beer production was Delft's leading economic activity during the Middle Ages. Beer

was exported to many cities in the western parts of the Netherlands. Furthermore, population density caused an increase in fire-risk. Local acts dictated new buildings to be made constructed using stone instead of wood.

Lack of food and pestilence during the second half of the 16th century and the beginning of the 17th century, especially during the revolt against Spain, reduced the number of inhabitants dramatically to about 20.000 at about 1600 AD.

Against this socio-historical background there are some questions to which a physical-anthropological study of cemetery skeletons can give some clues.

--- Was population increase caused by local growth or was it a the result of immigration?

--- What was the age and sex composition of the Delft population and what was its health status? Did it change by the dramatic expansion of the city, and resulting increase of its population? In other words, were the adjustments made by municipal planners adequate to cope with these changes?

The following historical outline of the City of Delft and its infirmary will help to elucidate these questions.

History of the infirmary

The infirmary was originally called the "Heilige Geest Gasthuis" (Holy Ghost Infirmary; Gouweleeuw, 1970). Since the end of the 14th century its name changed to the "Oude Gasthuis" (Old Infirmary; Annema, 1979), and since 1557 the "Oude en Nieuwe Gasthuis" (Old-and New Infirmary). The infirmary remained in use as a hospital until 1968. At this time it was moved out of the city centre of Delft. Until its relocation, this public health service had lasted for more than 700 years at the same site.

The infirmary was located in the southern periphery of the medieval City of Delft, east of one of the canals, which was originally called the "Nieuwe Delft" and which was later renamed to "Koornmarkt" (Fig. 1). It was one of the new institutions which was founded soon after the above mentioned privileges of 1246 AD. Since a papal bull from 1252 AD confirmed the existence of the so-called "*hospitale de Delft cum omnibus pertinentiis suis*", it follows that the infirmary was founded in or just before 1252 AD (Oosterbaan, 1954). It belonged to the Premonstratensian monastery called "Koningsveld", which was actually situated outside Delft. After 1459 AD, the infirmary was managed almost completely by the Delft municipality.

It was not uncommon for the Premonstratensians to run an infirmary, since one of their tasks was to take care of the poor and homeless. They chose to locate the infirmary on the fringe of the new town and not at the convent itself since the need for a public health service in Delft was increasing due to a growing population. The task of this infirmary was threefold: to take

care of the sick or disabled, to give temporary shelter to vagabonds and wayfarers, and from around 1400 AD onwards to house aged people. The latter had to pay for their stay.

A permit to found an *oratorium* and to install a chaplain was given on January the 14th, 1264 AD (Oosterbaan, 1954). A year later, October the 24th, the right to have a churchyard outside the chapel ("*juxta eorundem capellam*") was added. This "*jus funerandi*", the right to bury people, was limited to brothers and sisters of the congregation of the infirmary, and to the poor who deceased there. By 1350 AD the old churchyard became overcrowded and was in need of expansion. On July the 7th 1351 AD, the new churchyard of the infirmary was consecrated by the Bishop of Utrecht. On July the 10th of the same year, he consecrated a second cemetery in the chapel itself ("*intra muros ecclesiae*"; Oosterbaan, 1954). Nevertheless, more space was still needed to bury the dead. Probably, the cemetery in the chapel was meant for the privileged. There is no indication that the original "*jus funerandi*" was extended in 1351 AD to include other categories of people beyond those mentioned in the permit of 1265 AD. But it can be deducted from the archives that the "Oude Gasthuis" possessed the right to bury other categories of people by 1422 AD (Oosterbaan, 1954). Officially, the cemetery stayed in use until 1652 AD. In practice, it closed a few decades earlier (Annema, 1981).

Before 1343 AD adjacent parcels of land were bought to extend the infirmary. The complex existed of four main buildings: a hospital for the sick, a "baaierd" to give shelter to vagabonds, a chapel and a churchyard. In addition, a number of annexes were founded on the complex, in which e.g. the staff was housed.

On January the 6th, 1433 AD Bishop Gillys of Utrecht came to the "Oude Gasthuis" to consecrate the altar "beneden tchoir an die noortside" (in front of the choir against the northern wall). This consecration gave us a clue as to when the chapel was built.

In 1536 AD, a disasterous fire in Delft destroyed the infirmary. Although the "Oude Gasthuis" was on the periphery of the fire, most buildings were ruined and had to be rebuilt. A painting of the city plan, just after the fire shows a ruined chapel and all of the buildings north of it. Only some buildings south of the chapel and two annexes along the east end of the block remained intact. It is unknown how much time was needed to repair all of these structures.

For almost 150 years, the infirmary at the "Koornmarkt" was the only medical institution in Delft. But by the end of the 14th century, more institutions offering public health services were created. Some of these institutions had special purposes that could have affected the population composition of the "Oude Gasthuis". Therefore it is necessary to specify which categories of people may have been diverted from the potential "Oude Gasthuis"”

population during a certain period.

--- The rich. Those who could afford it were treated at home. If they died, they were buried in one of the two parish churches, or at one of the graveyards belonging to the monasteries in Delft.

--- Lepers. Even before 1389, lepers were treated in a leper hospital outside Delft. They were also buried there.

--- Vagabonds. The "St. Jorisgasthuis" was founded at the end of the 14th century and was used to give shelter to female travellers and vagabonds. From then on the "Oude Gasthuis" was used to house homeless males only (Annema, 1979).

--- The eldery. For poor elderly woman, the "St. Marthahuis" was founded around 1400. In 1411, the "Oude Mannenhuis" was founded for poor elderly man. Both institutions buried their inhabitants in their own grave yards.

--- Children. Infants were care for by a foundling asylum which became an orphanage in the middle of the 15th century. It is not known whether they were buried apart, or in one of the regular cemeteries.

--- Pestilence sufferers. In 1557 AD the "Convent of Maria Magdalena" was claimed by the local government and turned into a center specializing in the care of pestilence sufferers (Bult, 1993). It is estimated that about a fifth of the population died from the plague in that year (Houtzager, 1979). Somewhat later, in the beginning of the 17th century, this plague again caused many deaths. The victims were buried in a special cemetery near the "Convent of Maria Magdalena", in collective graves and a related charnel pit at the "Schutterstraat" (Bult, 1993).

From these data it may be expected that children and very old people could be under-represented in the "Oude- en Nieuwe Gasthuis" cemetery. Such a deviation could even be more extreme in the so called "Late Period" (1433-1652 AD; see below). Furthermore, the population of this cemetery should be regarded as coming from the lower socio-economic classes in the Delft society.

Archaeology

The excavation of the cemetery took place in the late fall and winter of 1985 and 1993 (Kistemaker, et al., 1985; Bult, 1995). Dutch climate conditions hampered the excavations. Due to the wet and clay-rich soil, most of the organic material like bones, wood and leather were well-preserved. Only in the upper levels of the burial soil, were conditions less conducive to preservation because of the presence of debris and more oxygen. Still, the majority of the skeletons was fairly intact. Nevertheless, disturbances and later burials had removed parts of previous buried individuals. Skeletons within the excavation area but extending over the borderline of the pit could only be partly recovered.

Since this report is focused primarily on the physical

anthropological analysis of 102 skeletons, the archaeological evidence presented here is restricted to information related to the cemetery, the dating of the burials and the burial types. As one of our questions concerned possible changes in the age/sex structure of the population and its health status, only those graves which could be assigned to the "Early or Late" burial period were analyzed. Approximately the same number of skeletons from both periods was randomly sampled.

Recognition of burial periods

Archaeological research on the cemetery and the chapel made it possible to distinguish two subsequent burial periods. This distinction is based on the placement of the burials and on the foundations of the chapel (Fig. 2 and 3). Due to the enlargement of the chapel, the choir of the old chapel was demolished (Bult, 1995). Burials outside of the old chapel, which were (partly) disturbed by the construction of the new choir, can be considered older than the time at which the chapel was extended. Analysis of a so-called Harris-matrix showed which burials belonged to this group. They are referred to as the so-called "Early Period" burials. Graves which were intersecting (i.e., cutting into) the foundations of the demolished choir of the old chapel, are considered to be more recent than the enlargement of the chapel. To these burials a group of intersecting graves can be added. This group of burials is referred to as the "Late Period" burials.

Dating of the burial periods

The archaeological dating of the cemetery is based on brick dimensions used in the construction of the chapel (Fig. 4, nr.1). The brick dimensions of the oldest chapel were the standard format in Delft during the second half of the 13th century (31/30 x 15/14 x 9/8 cm). It matched with the historical date of 1265 AD, when the chapel was mentioned for the first time. At the same time, a permit was given to construct a churchyard. There are no indications that interments were practised before the construction of the chapel. Therefore, it can be concluded that all burials date from after 1265 AD.

The enlargement of the chapel is archaeologically dated in the second quarter of the 15th century. The dating is also based on the dimensions of the bricks used in the foundation of a large choir, which replaced the older one (22.5 x 10.5 x 5.5/5 cm; Figure 4, nr. 5). The historically known date of the consecration of an altar in 1433 AD fits perfectly in the archaeological dating of this expansion, i.e., in ca. 1433 AD.

In sum, burials which are intersected by the foundations of the enlarged chapel and the graves which are intersected by these burials (and are therefore even older), belong to the so-called "Early Period" which can be dated at 1265-ca.1433 AD. Consequently, the so-called "Late Period" dates ca.1433-1652 AD, after which the cemetery was closed (see above).

Burial types and practices

Final analyses of the burial types and burial practices are not yet available. Nevertheless it can be stated that these practices correspond to the usual Christian way of interment. In a medieval Christian cemetery almost all individuals had a very basic burial in a coffin. The corps was extended on its back, the head towards the west and the feet pointing to the east. The arms were stretched along the body, sometimes one or two hands were placed on the lap. Grave goods and ornaments were absent. No garments or attributes of clothing were found, except for one person who was buried wearing leather shoes. This indicates that people were not buried in their usual outfit, but probably in a (linen) shroud. A variant of this burial type was an interment without a coffin (Fig. 3). This variant was found in graves from the "Early Period," particularly at the deepest levels of this period. Consequently, these were the earliest graves in the cemetery.

PHYSICAL ANTHROPOLOGICAL INTRODUCTION

A collection of 101 skeletons from the burial place of the infirmary "Oude en Nieuwe Gasthuis" of the City of Delft was studied. The burials dated from the Late Mediaeval Period to the 17th century. The collection is assumed to represent the mortality of a typical infirmary population of two distinct but subsequent periods: the so-called "Early Period" of 1265-ca.1433 AD and the so-called "Late Period" of ca.1433-1652 AD. The skeletons from the "Early Period" had been recovered from excavation area 1 and 6, and those from the "Late Period" from area 7 and 8 of the burial place (Figure 4). It is known (see the historical introduction above), that the City of Delft developed substantially during this time period in terms of size, economic activity and population growth. It is also known that the municipality made adjustments to these ongoing expansions (see the archaeological introduction). Did these changes affect life conditions in terms of health status as reflected in the dead of the infirmary? To trace indicators of a change in health, the main demographic features and the health status of the buried from the "Early"- and "Late Period" were analyzed and compared.

MATERIALS AND METHODS

Materials

A well-dated random sample of 52 skeletons from the "Early Period" (1265-ca.1433 AD; area 1 + 6), and 49 skeletons from the "Late Period" (ca.1433-1652 AD; area 7 + 8) was collected. The skeletons were relatively complete and bone tissue preservation itself was moderate to good. As an indicator of this, the postmortem tooth loss from observed alveoli (tooth sockets) was ca. 7.5% (see "Results").

Methods

After articulation and reconstruction of the bones of each skeleton a standardized Physical Anthropological Report was completed (Maat, 1995). This included a record of the cranial and postcranial status of completeness, of found pathological changes, of the horizontal cranial index (maximum skull breadth x 100 / maximum skull length; Knussmann, 1988), and of the dental status according to Brothwell (1981), and Bouts and Pot (1989). See below for definitions with respect to dental features.

The report also comprised an analysis of the non-metrical morphological degree of sexualization of the pelvis, cranium, mandible, and the whole skull according to the WEA (1980).

In addition the report included a determination of the skeletal age at death. Age indicators for non-adults were: dental eruption after Ubelaker (1978), ossification of axial skeleton according to Maat (1995), long bone length with or without epiphyses after Maresh (1955), and epiphyseal fusion of the postcranial skeleton

(WEA, 1980). Resulting ages at death were sufficiently precise to assign each non-adult to an age at death interval of 5 or 10 years.

For the skeletal age at death determination of adults, a procedure known as the Complex Method which is based on four or less age indicators was used (Nemeskéri et al., 1960; Acsádi and Nemeskéri, 1970; Sjøvold, 1975). These age indicators were age related changes of the symphyseal face of the pubis, the spongiosa of the proximal femur, the spongiosa of the proximal humerus, and the endocranial sutures. To assess the phase of the last three indicators, it was necessary to cut these bones with an electric band saw. The resulting ages at death based on four or three of the indicators were adequate to assign each individual to an age at death interval of 10 years. In cases where only one or two age indicators were available, the age at death interval was settled by seriation according to molar attrition after Maat and Van der Velde (1987). It should be mentioned here, that e.g. "Interval 2" stands for the period 20.0 to 29.9 years of age, etc..

Finally the report included the determination of the standing living height of adults from the anthropometric measurements of various long bones as defined by Knussmann (1988). The stature of adult males was computed according to Breitinger (1937), and Trotter and Gleser (1958). The stature of adult females was calculated according to Trotter and Gleser (1952) only.

Definitions and abbreviations with respect to adult dental features:

Number of erupted teeth (N erup):
number of erupted teeth, with respect to estimated numbers of undeveloped, unerupted and supernumerary teeth.
Number of teeth inspected (N insp):
number of observed teeth.
Antemortem loss (AM loss):
number of observed resorbed or resorbing alveoli.
Postmortem loss (PM loss):
number of observed empty alveoli with sharp edges.
Postmortem alveolar loss (PM alv l):
number of postmortem lost alveolar spaces.
Number of carious teeth (N car):
number of observed teeth with carious lesions.

Antemortem loss (%): percentage of observed alveolar spaces with AM loss.

$$\frac{\text{AM loss} \times 100}{\text{N erup} - \text{PM alv l}}$$

Postmortem loss (%): percentage of observed alveoli with PM loss.

$$\frac{\text{PM loss} \times 100}{\text{N erup} - \text{PM alv l} - \text{AM loss}}$$

Caries frequency (%): percentage of observed teeth with carious lesions.

$$\frac{\text{N car} \times 100}{\text{N insp}}$$

Abscess frequency (%): percentage of observed alveoli with an abscess.

$$\frac{\text{N absc} \times 100}{\text{N erup} - \text{PM alv l} - \text{AM loss}}$$

DM(F) Index (%): Decayed-Missing (Filled) Index: percentage of alveolar spaces with observed teeth or antemortem lost teeth, which show carious teeth or AM loss.

$$\frac{(\text{N car} + \text{AM loss}) \times 100}{\text{N erup} - \text{PM alv l} - \text{PM loss}}$$

At all times, percentages are calculated from "possible cases", i.e., from observable specimens! Only unequivocal cases were taken into account.

RESULTS

A survey of the most basic physical anthropological results for the so-called "Early Period" (1265-ca.1433 AD) and the "Late Period" (ca.1433-1652 AD) is presented in Table 1 and 2.

Horizontal cranial Index

The mean horizontal cranial index of the people from the "Early Period" was 83.2 (N=27; s.d.=3.4), which falls within the brachycranic range of 80.0 and over. On the average these skulls appeared to be short for their breadth. In contrast, the index for the "Late Period" was 78.5 (N=18; s.d.=4.7), which falls within the mesocranic ("normal") range of 75.0-79.9. Student's two-sample test showed, that the difference in mean index between the samples from the "Early" and "Late Period" was very significant (p=.000, which is <.05).

Sex

Sex could be determined in 89 cases, i.e., in 98% of the total sample (Table 3 and 4). The distribution of the pelvic degree of sexualization was bimodal with its lowest intermediate frequency at 0.00-0.25 (Fig. 5). Theoretically, the ultimate indeterminant degree of sexualization should be 0.00. Because of this sound distribution, preference was given to pelvic sex diagnoses in the only two cases in which the skull gave a conflicting result. Of the adults from the Early Period, 59% (N=27) were male, 37% (N=17) were female, and 4% (N=2) were of indeterminant sex. Of the adults from the "Late Period", 47% (N=21) were male, 53% (N=24) were female, and no one appeared to be of indeterminant sex.

Age at death

The appropriate age at death interval of 10 years could be determined in 90% (N=47) of the individuals from the Early Period, and in 78% (N=38) of the individuals from the "Late Period" (Table 5 and 6). For both periods the age at death distributions are shown in Table 7 and in Figure 6. Percentage of individuals under 20 years of age in the "Early" and "Late Period" was 21% and 16% respectively. For both periods there appeared to be a relatively few number of deaths in 30-40 years interval. The overall mean age at death for the population over 20 years of age during the "Early" and "Late Period" was 45 and 46 years respectively. In both periods life expectancy for females was higher if compared to males. For females and males over 20 years of age life expectancy during the "Early" and "Late Period" was 47(♀) and 43(♂), and 49(♀) and 43(♂) years respectively.

Standing living height of adults

In the Early Period (Table 8), the mean stature of adult males calculated after Breitinger was 170.5cm (N=25; s.d.=4.6), and after Trotter and Gleser (if not corrected for loss of stature by ageing) was 171.8cm (N=24; s.d.=5.7cm). Mean stature of the

females after Trotter and Gleser (if not corrected for loss of stature by ageing) was 164.4cm (N=14; s.d.=7.8cm). As a result, the estimated sexual dimorphism (difference) in body length was 7.4cm.

In the "Late Period" (Table 9), the mean stature of the males after Breitinger was 168.9cm (N=19; s.d.=3.4cm), and after Trotter and Gleser (if not corrected for loss of stature by ageing) was 170.8cm (N=19; s.d.=4.3cm). The mean stature of females after Trotter and Gleser (if not corrected for loss of stature by ageing) was 162.2cm (N=20; s.d.=7.1cm). Here the estimated sexual dimorphism was 8.6cm. Student's two-sample test showed that the difference in mean male stature (calculated after Breitinger or Trotter and Gleser) between the samples from the "Early" and "Late Period" was not significant (p=.24 and .53 respectively, which are both >.05).

In the future comparisons on stature using the Maximal Femoral Length will be of interest, because it is felt that femur lenght will give a better, more direct, estimation of height differences than calculated statures based on varying combinations of bones (Table 1, 2 and 10). In the "Early Period the mean for males and females was 46.0cm and 44.2cm respectively. In the "Late Period" the mean for males and females was 45.5cm and 43.4cm. All differences between data from the "Early" and "Late Period" were not significant (p=.49-.52, which is >.05). But the difference between males (45.8cm) and females (43.7cm) for the overall period was very significant (p=.001, which is <.05).

Dental status

Dental examination was possible on complete and incomplete jaws of 39 skeletons from the "Early Period" (75%), and on 30 skeletons from the "Late Period" (61%). A total count on their dental status is given in Table 11.

In the "Early Period" 762 of a total of 1198 erupted teeth was observed. Antemortem loss was 16.2% and postmortem loss was 4.5%. The caries and abscess frequency was 7.6% and 7.1% respectively. The DM(F) index was 22.5%.

In the "Late Period" 527 of a total of 926 erupted teeth was observed. Antemortem loss was 19.1% and postmortem loss was 11.8%. In this period the caries and abscess frequency was 12.3% and 5.9% respectively. The DM(F) index was 30.1%.

Tartar (calculus) formation was defined as "light' in both periods. Remarkable was one case of heavy unilateral depositing in a 62 years old female from the "Early Period" (Fig. 7).

Main pathologic bone changes in adults

A total count and frequency distribution of main pathologic changes and anomalies found in adults from the "Early Period" are enlisted in Table 12 and 13, and from the "Late Period" in Table

14 and 15. Although many pathologic changes and anomalies were found, only those notable for their unusual degree of expression or unusually high frequency will be mentioned here. These and common disorders will be discussed in the "Discussion".

Notably for the "Early Period":

Seven individuals, three males and four females, had healed fractures of various bones. An example is shown in Figure 8.

Two males and one female had a healed skull wound due to mechanical trauma (9%).

A male showed maxillary sinusitis caused by an apical tooth abscess.

A 36 years old male with tuberculosis of the spine suffered from an angular kyphosis due to collapsed lumbar vertebras (Fig. 9).

Two cases were found with osteoclastic (bone destructive) tumor metastases (4%).

A 46 years old male suffered from Scheuermann's disease (2%; Fig. 10). At the thoracic level fragmentation of vertebral endplates, wedging vertebral bodies and pseudo-Schmorl's nodes (intervertebral surface impressions) were noted. Scheuermann's disease is an osteochondrosis of the spine caused by hampered vascularization of the intervertebral discs (Zimmermann and Kelley, 1982). It produces a kyphosis, which is an abnormal backward curvature of the spine. The deformity develops in adolescents with a strong predilection for males.

Four persons had DISH (Diffuse Idiopathic Skeletal Hyperostosis or Forestier's disease; 8%). In this systemic disease there is a strong tendency to develop enthesopathies with increasing age, i.e., ossified entheses (ligaments, membranes, muscle insertions, joint capsules) and ossified cartilagenous structures. Most characteristic are the ossifications of the right anterior longitudinal ligament of the thoracic spine, the so-called fused "candle wax" ossifications. Moreover this disease is characterized by additional enthesopathies at extraspinal sites (Rogers and Waldron, 1995). Usually, disc spaces and synovial joint cavities themselves are maintained.

Ten cases with non-systemic multiple enthesopathies were found (20%).

Moreover, with increasing age numerous adults with degenerative arthropathies have been found. Vertebral osteophytosis (VO; degenerative disc disease) was seen in 38% of the spines. VO is a with age increasing degeneration of the fibro-cartilagenous intervertebral disc resulting in Schmorl's noduli (disc impressions) in the vertebral body surface and marginal

osteophytes (bone outgrowths) along the vertebral bodies. No cases were found under the age of 20 years.

The same held for osteoarthritis (OA) also known as arthrosis. Vertebral osteoarthritis (vOA), a with age increasing degeneration of the synovial joint cartilage of the facet joints of the vertebral arches resulting in marginal osteophytes and eventually in eburnation (polishing) of the joint surface, was recorded in 16% of the spines. Periferal osteoarthritis (pOA) is the same disease but localized in extraspinal synovial joints. Although it is more common in females than males (Rogers and Waldron, 1995), it appeared to be more present in males in our five cases.

The following were notable for the "Late Period":

Three males and two females had various healed fractures by mechanical traumas.

Three individuals had an unilateral periostitis of their leg bones due to an infection from a skin perforating mechanical trauma(9%).

Two individuals showed a suppurative (pus producing) arthritis: one of a hip joint and another of an elbow joint (4%; Fig. 11). Both were due to infection.

Also in this period a case of tuberculosis, now complicated by an angular kyphosis of the thoracic spine, was discovered (2%; Fig. 9). The affected male of 30-60 years old also showed extraspinal tubercular changes in the greater trochanter of his right femur and on the interior periosteal surface of his ribs.

Three cases of osteochondritis dissecans were found: one male and two females (Fig. 12). The lesions are the result of fragmentation and probable disruption of articular cartilage consequent upon trauma (Rogers and Waldron, 1995). Usually it is more common in males than females. The knee was the affected joint in 90% of the cases.

Nine persons had DISH (20%), and four had non-systemic enthesopathies (8%).

Also in this group of adults many examples of degenerative arthropathies were found: 21 cases of vertebral osteophytosis (VO; 44)%, 7 of vertebral osteoarthritis (vOA; 15%), and 17 of periferal osteoarthritis of various extra-spinal joints (pOA; Fig. 13).

DISCUSSION

Since overall postmortem tooth loss was only ca. 7.5%, we may conclude that the skeleton collection from Delft was well preserved. If compared to other excavated collections from the same period, e.g. of late medieval citizens from Dordrecht, it is even very low (37.4%; Maat et al., 1998).

With respect to the form of the skull, it appeared that the average horizontal cranial index of the people from our so-called "Early Period" (1265-ca.1433 AD), was statistically very significantly different from our so-called "Late Period" (ca.1433-1652 AD). In the former group the skulls were strongly brachycranic (average index: 83.2), whereas in the latter the skulls were mesocranic ("normal"; average index: 78.5). Except for the inhabitants of the northwestern islands of the province of Zeeland where brachycrany is said to dominante, the present population of The Netherlands is generally mesocranic or even dolichocranic (Constandse, 1968; Salomé, 1969). Remarkably, brachycrany was also found to be the rule in a group of late medieval skeletons from Dordrecht (cranial index 82.3; 1275-ca.1433 AD; Maat et al., 1998). Could there be a migratory link? Geographically both cities are situated quite closely to Zeeland! But, it should be mentioned here, that there is a growing body of data indicating a tendency for medieval populations in Western Europe to become increasingly brachycranic (i.e., a cranial index larger than 80; Cross and Bruce, 1983; Stroud and Kemp, 1993). Hence, it becomes impossible to conclude if population growth of the City of Delft was caused by substantial immigration and/or by local population growth.

Since evaluation of our results from the non-metric pelvic sex determinations showed that calculated "degrees of sexualization" were properly distributed at both sides of the sectioning point, we consider our sex diagnoses from pelvices to be very reliable (Fig. 5). In contrast to the sample from the "Late Period", adult males outnumbered adult females in the "Early Period". Like in our "Late Period", it would have been expected to find a slight female dominance in adults. It is known that during the "Early Period" there was a violent siege of the City of Delft by the Duke of Holland in 1359 AD, and that in this same period there had also been continuously violent conflicts between the political fractions of the "Cods" and "Hooks" ("Kabeljauwen" and "Hoeksen"). We wonder if that might have led to an influx of (wounded) men into the infirmary population. It would explain the surplus of men in the burial area of that period.

The age at death distribution indicates a lack of children and youngsters under 20 years of age for both the "Early" and "Late Period", 20% and 16% respectively. Especially children under 10 years are missing (see Table 7, 6.4% and 5.3% respectively). In pre-industrial European cemeteries some 30% of children are to be expected (Waldron, 1994). A lack of children in a cemetery can

have many causes. Often bones of small children are so delicate that it is difficult to discover them during the excavation at all. Sometimes these small bones are mistaken for those of animals, especially of fowl. But in our case it is important to keep in mind that the collection represents the medieval inhabitants of the "Oude en Nieuwe Gasthuis" infirmary. In the "Late Period" children with health and social problems were not sent to the infirmary, but to the foundling and orphan asylum of Delft, and thus were most probably buried elsewhere.

The overall mean age at death for adults of both populations shows little difference, 45 and 46 years of age. Viewed apart, the same holds for males and females from both periods. The mean age at death for females is somewhat higher than that for males. This is commonly found in literature. It is ascribed as a natural slightly higher life expectancy for females. Basically, the overall age at death distribution for both periods respects the typical U-distribution of a paleopathological population which died by ageing (Fig. 6). Characteristic is the relative low death rate for those who are in the prime of their lives, the 30-40 age interval. After this interval, we see a natural increase in deaths due to ageing. In the group of very old, only a few are still alive and will die. In contrast to modern developed societies, such a demographic profile is compatible to that of under-developed or developing countries at the present time (Waldron, 1994).

There was no demographic evidence of a plague epidemic, which would have resulted in an altered age at death profile of the buried population. From archaeological and historical data we know, that there was a special place for plague victims at that time: the Maria Magdalena Convent, with its cemetery of collective graves in the "Schutterstraat" (Bult, 1993). The age at death profile of a charnel pit from that site is shown in Figure 14 (Onisto and Maat, 1995; minimum number of individuals 57; sex determination by non-metrical morhological features of 33 skulls: 49.5% males, 50.5% females; age at death determination by assessing epiphyseal union status and spongiosa structure of 57 femurs). Its unimodal profile, typical for a random sample of an acutely inflicted living population, contrasts as it should with the typical bimodal U-shaped profile of the population which died by ageing in the "Oude en Nieuwe Gasthuis" (Fig. 6).

It is commonly reported in the literature, that the stature of females is substantially shorter than that of males (ca. 8cm). Since sexual dimorphism in stature usually varies between 8 and 10 cm, our finding indicates that calculations from our small samples are consistent with such expectations. According to the calculations made after Breitinger (1937), there appears to be a small but not statistically significant difference in body length between males from the "Early Period" (1265-ca.1433) and the "Late Period" (1433-1652 AD). The males in the "Late Period" are approximately 1.6cm smaller (168.9cm)! Of course, this

difference could be due to small sample size. But on the other hand, since we know that males were even smaller in the 17th and 18th centuries (166.0-166.7cm; Maat, 1990), it could well be a signal of a coming general decrease in stature.

Stature is considered to be a parameter of the general socio-economic status of a population (e.g. van Wieringen, 1972). Therefore, a comparison is made of our results with those based on young adult Dutchmen from the 17th century to the present time (Maat, 1990). To avoid the effect of any stature decrease by ageing, only data of men from the age interval 20.0-29.9 years were used. And only our statures calculated after Breitinger (1937) are interpreted, since his method is said to be the most appropriate for European men living north of the Alps (Wurm and Leimeister, 1986). The stature of our young men from Delft was 170.5cm in the "Early Period" and 168.9cm in the "Late Period". It can't be coincidence, that the adult males from Dordrecht (1275-1572 AD, which are from more or less the same period) were of about the same length (170cm after Breitinger; Maat et al., 1995). Compared with young Dutch males from the 2nd half of the 17th and the 18th centuries (166.0-166.7cm; Maat, 1990) all the late medieval men from Delft and Dordrecht are ca. 2.2-4.5cm taller! Thus, the stature of our overall group is probably not only typical for the socio-economic status of the City of Delft, but also for the entire population of The Low Countries of the Late Medieval Period. With respect to socio-economic (growth) conditions, people were probably better off than in the successive period, the second half of the 17th and 18th centuries.

For comparisons between statures from different periods Maximal Femoral Lenghts were recorded. In contrast to formulas developed for stature calculation (e.g. Breitinger, 1937; Trotter and Gleser, 1952, 1958) the use of femoral lengths only is not biased by differences in design between available formulas, nor by the use of varying combinations of available long bones per individual. Although our results cannot yet be compared with others, it is important to mention that the difference found in mean femoral length between males and females was very significant ($p=.001$). This is consistent with the expectation that male dimensions are larger than those of females.

To have an idea about the health status of teeth and the kind of diet people could have had, we looked into the frequency of the carious teeth for both periods. If we compare our results from our "Early Period" 7.6% with those from other contemporary collections, our frequency is more or less the same as in mediaeval Britain (6.1%, 950-1550 AD, Dawes and Magilton, 1980; 6-7%, 1066-1500 AD, Moore and Corbett, 1983) and in mediaeval Denmark (7%, 1276-1540 AD, Brøndum, 1981). But our higher frequency of 12.3% for the "Late Period" was only found in contemporary Fishergate in York by Stroud and Kemp (12.1%; 1993). They presumed that this higher frequency reflected the relative

wealth of their buried ("canons and the wealthier segments of the lay population with a more refined diet"). The frequency for our "Late Period" (1433-1652 AD) may be high too, but nevertheless it fits in well with that of Dutchmen from the following 17th and 18th centuries (13.4%!, Maat and Van der Velde, 1987). The difference in frequency between our "Early" and "Late Period" seems to indicate that something has changed in the diet during the end of the Mediaeval Period. We assume that the crucial change was a decrease in the coarseness of foodstuffs, especially of flour products by the introduction of cloth sieves. This development led to less occlusal attrition and consequently to an increase in carious teeth (Maat and Van der Velde, 1987).

Although the overall degree of tartar formation appeared to be slight, one exceptional case of heavy unilateral depositing in a 62 years old female was found. This rare phenomenon is probably due to an inability to chew on that side from a hemi-facial paralysis (Arcini, 1995).

The pathologic bone changes in the skeletons were studied with particular interest. A comparison was made between our two groups and also with other Dutch collections from the same period.

In the so-called "Early Period" a high percentage of healed skull wounds was found (9%; 2 males and 1 female), while none were recorded in the so-called "Late Period." Even if compared to data from contemporary citizens from Dordrecht (4%; Maat et al., 1995) the score was high. Could there be a relationship with the surplus of excavated males from the same period (combat trauma?)? We mentioned before the violent siege of the city by the Duke of Holland in 1359 AD, and the political struggles between the "Cods and Hooks" in this time period.

In the "Early Period" a female was found with femoral squatting facets and spondylolysis of her 5th lumbar vertebra. The former change from the habit of squatting was widespread in pre-Neolithic times (Molleson, 1994), and was still found in a high frequency among the Romano-Dutch population during the Roman Period (11% at the ankle joint; Lonnée and Maat, 1998). It is known to be rare in more developed communities. Since it is generally accepted that spondylosis results from heavy physical (agricultural?) labor (Merbs, 1992, 1995), the combinaton of both changes in one individual may indicate a rather primitive and tough life.

In both periods cases of periostitis have been recorded. In contrast to modern societies, infectious disorders are commonly found in archaeological populations. Unilateral periostitis of leg bones was recorded in both periods, but with a relative high incidence in the "Late Period" (9%). Even if compared to contemporary citizens from Dordrecht this frequency was hight (5%; Maat et al. 1995). On the other hand, both frequencies are low if compared to contemporary Fishergate, York (11-36%; Stroud

and Kemp, 1993). In most cases unilateral periostitis of the leg is caused by a skin perforating mechanical trauma of the tibia.

Osteomyelitis was another common clinical condition before the availability of antibiotics. Only one case was found in the "Early Period". Of the two cases of suppurative (pus producing) arthritis from the "Late Period" (4%), one was located in the hip joint, the other in the elbow joint. In the literature on paleopathology, predilection sites are the large periferal joints indeed (Ortner and Putschar, 1981). Children are affected more frequently than adults. Our two cases were two young males.

In both periods we have cases of tuberculosis in an adult man (2%). Both are characterized by an angular kyphosis due to collapsed infected vertebras. The spines show the typical ankylosis of vertebral bodies and lack of bony reaction at the infection site. Usually, in 25-50% of cases the vertebral column is involved. Often the first lumbar vertebra is the initial site of spinal tuberculosis (Steinbock, 1976). Although highly characteristic, collapse of vertebral bodies is not very common. Of 100 cases of spinal tuberculosis, 10% exhibit body bridging. We suppose that both individuals went to the infirmary where they eventually died due to the seriousness of the disease. In conclusion we should mention here that infectious diseases did not predominate in either of our periods.

Also, only a few cases of deficiency diseases from malnutrition were found. In the "Early period" one man with rickets and in the "Late Period" one child with cribra orbitalia were recorded. The former is caused by a deficiency of vitamin D, due to lack of animal fat and/or sunshine. The latter change is a response to chronic anemia developed during infancy. The frequencies of our deficiency cases is low if compared to contemporary citizens from Dordrecht (rickets 6%; cribra orbitalia 2%; porotic hyperostosis 2%; Maat et al., 1995), and from Fishergate in York (64% cribra orbitalia in subadults!; Stroud and Kemp, 1993). It reconfirms our opinion, as already stated with respect to stature and infection diseases, that the socio-economic and overall health situation of this population was reasonably good for both periods.

In the "Early Period" there was one case of a cranial osteoma (3%), while in the "Late Period" there were two cases (7%). This is the same percentage as found in the citizens of Dordrecht (Maat et al., 1995; 1275-1572 AD). Basically, it is one of the most common and benign bone tumors in humans. As in our case, the majority are button osteomas.

Only in the "Early Period," two skeletons with osteolytic tumor metastases were found. Both were females; one was 55-63 years old, and the other 28-36 years. The age of the former victim, the distribution pattern of her metastases and the errosive and non-reaction inducing nature of the tumor growth, indicated that the

primary tumor could very well have been a mamma tumor (Zimmerman and Kelley, 1982).

A very uncommon disease known as Scheuermann's disease was found in a male of 46 years old from the "Early Period." This osteochondrosis produces a juvenile kyphosis, and is caused by hampered vascularization of the intervertebral discs (Zimmermann and Kelley, 1982). The deformity develops in adolescents with a strong predilection for males. Usually, the apex of the kyphotic curvature falls close to the 8th-10th thoracic vertebra (Ortner and Putschar, 1985). Also in our case the main changes were at the thoracic level: fragmentation of endplates, wedging of vertebral bodies and pseudo-Schmorl's nodes. It should be mentioned here that references to such spinal deformities are rare in the paleopathological literature (Ortner and Putschar, 1985). This is probably because vertebras are not as well preserved as many other parts of the skeleton. In addition, kyphosis can only be diagnosed if one takes the trouble to articulate a complete spine.

In the "Late Period," three cases of osteochondritis dissecans were found (6%), one in a male and two in females. This disease is quite often recorded in the paleopathological literature. The lesions are the result of fragmentation and probably disruption of articular cartilage following trauma (Rogers and Waldron, 1995). Usually it is more common in males than females. The knee is the affected joint in 90% of the cases.

A high percentage of Diffuse Idiopathic Skeletal Hyperostosis (DISH) has been found in the skeletons of both periods (8-19.6%), particularly in the "Late Period". Clinically, this disease is characterised by ossifications of connective tissue and cartilage. It may result in fusion of adjacent thoracic vertebras. Facet joints of the spine are usually not involved and the disc spaces are maintained. Moreover this disease is characterized by the ossification of many extraspinal sites (Rogers and Waldron, 1995). Our frequency for both periods is also high when compared to that for the citizens of Dordrecht from the same period (15%; Maat et al., 1995). As usual, the disease was more common in males than females, and its prevalence increased with age (Rogers and Waldron, 1995). Epidemogically, a similar pattern is seen in the recent Dutch population (van Saase et al., 1989).

Enthesopathies, are isolated cases of new bone formation at the insertions of ligaments, tendons and muscles. Such changes should be distinguished from DISH, where spinal changes predominate. In the "Early Period" we found more cases (20%) than in the "Late Period" (8%). Enthesopathies may result from repeated trauma, and thus may be a useful indicator of the physical activity of this population. In fact, the majority of our cases were found in males from the whole period. There were only two females from the "Early Period" which developed enthesopathies.

Many anomalies, or anatomical variants, have been found in the samples from both periods. For instance a persisting sutura metopica was found in 6% of "Early Period" individuals. This condition is still frequently seen in various recent ethnic groups (mondially 7%; William et al., 1989). Spina bifida occulta, a congenital defect of the neural arch (9% "Early period", 5% "Late Period"), is a very common condition in ca. 10% of the people (William et al., 1989).

Regarding the frequency of degenerative arthropathies in adults, a distinction has to be made between the disorders:
--- vertebral osteophytosis (VO), a degeneration of the cartilaginous intervertebral discs, and
--- vertebral- or periferal osteoarthritis (vOA or pOA), a degeneration of the synovial joints between vertebral arches (i.e., facet joints) or between periferal bones (e.g. knees).
We noticed that our percentage of vertebral osteophytosis (VO; 38% in the "Early Period", 44% in the "Late Period") is not very high if compared to other populations from the same period [e.i., 71% in Dordrecht (Maat et al., 1995), 70% in Fishergate, York (Stroud and Kemp, 1993)]. Like in other populations no cases were found before the age of 20 years, and frequencies are about 2-3 times as high as those for vertebral osteoarthritis (vOA).

The frequency of osteoarthritis usually increases with age. It is more common in females than males (Rogers and Waldron, 1995). In our collections the frequencies of vertebral osteoarthritis (vOA) and of periferal osteoarthritis (pOA), increased with age as well, but more males than females suffered. This is probably due to small sample size. Finally, our frequencies of vertebral osteoarthritis ("Early Period" 16%, "Late Period" 15%) are much less than those for the citizens of Dordrecht from the same period (37%; Maat et al., 1995). If we take into account that our sample, in contrast to others, originates from an infirmary, then we have to interpret this result as another confirmation that the general health condition in late mediaeval Delft was on th whole not as bad as one might expect from such period.

CONCLUSION

The study of the human remains from the infirmary "Oude en Nieuwe Gasthuis" of the City of Delft (1265-1652) has produced a series of results which have shown to be complementary to historical and archaeological observations. After comparison of the physical anthropological findings from the two distinct, but subsequent periods (1265-ca.1433 AD and ca.1433-1452 AD) we have to conclude that differences in health status were minimal. Consequently we may conclude that adjustments made by the municipality to meet the ongoing expansion of the city, its economic activity and its increasing population during these two periods were adequate in terms of health status as reflected in the dead of the infirmary. In addition, life expectancy, stature, incidence of infections

diseases, deficiency diseases and joint degenerations show that the overall health situation in the City of Delft during the late Medieval Period was very reasonable. This is particular true if this period is compared to the following 17th and 18th centuries (Maat et al., 1984; Maat, 1984). It is also important to remember that the buried had been the sick, the vagabonds and the poor of those days who were given shelter by the infirmary.

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REFERENCES

Acsádi, G. and Nemeskéri J., 1970. History of human life span and mortality. Akademememiai Kiado, Budapest.

Annema, W., 1979. Ziekenhuizen, bouwkundige aspecten In: De stad Delft, cultuur en maatschappij tot 1572. Spaander, I.V.T. en Leeuw, R.A. (eds.). Delft: 69-72.

Annema, W., 1981. Ziekenhuizen. In: De stad Delft, cultuur en maatschappij van 1572 tot 1667. Spaander, I.V.T. en Leeuw, R.A. (eds.). Delft: 58-60.

Arcini, C. One-sided chewing. Homo 45 (suppl.): 12.

Bouts, W. and Pot, T., 1989. Burial Archaeology Current Research, Methods and Developments. BAR, British Series 211.

Breitinger, E., 1937. Zur Berechnung der Korperhöhe aus den langen Gliedermassenknochen. Anthropologischer Anzeiger, 14: 249-274.

Brøndum, N., 1981. The jaws and teeth of a mediaeval population in Svendborg. Ossa, 8: 43-52.

Brothwell, D.R., 1981. Digging up bones, 3rd ed. Oxford University Press, Oxford.

Bult, E.J., 1993. Archaeologische kroniek van Delft juni 1991-augustus 1992. In: Delfia Batavorum. Jaarboek 1992: 145-162.

Bult, E.J., 1995. Archaeologische kroniek van Delft juni 1993-juni 1994. In: Delfia Batavorum. Jaarboek 1994: 95-108.

Constandse, T.S., 1968. Fysisch antropologische beschouwingen over de Nederlandse bevolking: een poging tot synthese. Rotterdam.

Cross, J. and Bruce, M.F., 1983. Skull and face shape in Aberdeen in the 13th to 16th century. Journal of Anatomy, 137: 435.

Dawes, J.D and Magilton, J.R., 1980. The Cemetery of St. Helen-on-the-Walls, Aldwark. The Ebor Press, York.

Gouweleeuw, J.W.A., 1970. Inventaris van het archief van het Oude en Nieuwe Gasthuis te Delft. Delft.

Houtzager, H.L., 1979. De geneeskundige verzorging. In: De stad Delft, cultuur en maatschappij tot 1572. Spaander, I.V.T. en Leeuw, R.A. (eds.). Delft: 118-121.

Kistemaker, J.G.M., Buzing, G.Ph.M. and de Kat, H., 1985. Het Gasthuis grondig bekeken. Deel een: archaeologie en actie, Delft.

Kistemaker, J.G.M., 1990. Delft, een gasthuis grondig bekeken, In: Sarfatij, H. (ed.), Verborgen steden. Stadsarchaeologie in Nederland, Amsterdam, 123-127.

Kok, M.A., 1979. De sociaal-economische situatie in de zestiende eeuw. In: De stad Delft, cultuur en maatschappij tot 1572. Spaander, I.V.T. en Leeuw, R.A. (eds.). Delft: 98-100.

Knussmann, R., 1988. Anthropologie. Gustav Fischer, New York.

Lonnée, H.A. and Maat, G.J.R., 1998. Inhumed individuals buried in a Roman cemetery at Valkenburg-Marktveld (Zuid Holland) in The Netherlands. Barge's Anthropologica nr.3, Leiden.

Maat, G.J.R., Haneveld,G.T., van den Brink, M.R.M and Mulder, W.J., 1984. A quantitative study on pathological changes in human bones from the 17th and 18th centuries excavated in the "Hoogland Church", Leiden. In: Proceedings Paleopathology Association, 4th European Meeting Middelburg/Antwerpen, 1982. Haneveld G.T., Perizonius, W.R.K. and Janssens, P.J. (eds.). Paleopathology Association. Utrecht: 82-93.

Maat, G.J.R., 1984. A retrospection on the physical anthropological investigations in progress proceeding from the Spitsbergen expedition 1980. In: Smeerenburg. The sojourn of Dutch whalers on the westcoast of Spitsbergen in the 17th century. Hacquebord, L. (ed.). Dissertation, Arctic Centre. Groningen: 301-311.

Maat, G.J.R. and Van der Velde, E.A., 1987. The carries attrition competition. International Journal of Anthropology, 2: 281-292.

Maat, G.J.R., 1990. Growth changes in bones. In: Population of the Nordic countries. Human population biology from the present to the Mesolithic. Institute of Archaeology Report Series, University of Lund, 46: 88-93.

Maat, G.J.R., 1995. Physical Anthropological Report. Centre for Physical Anthropology, Leiden, pp.9.

Maat, G.J.R., Mastwijk, R.W. and Van der Velde, E.A.., 1995. Skeletal Distribution of Degenerative Changes in Vertebral Osteophytosis, Vertebral Osteoarthritis and DISH. International Journal of Osteoarchaeology 5: 289-298.

Maat, G.J.R., Mastwijk, R.W. and Van der Velde, E.A.. (in press 1998). Human remains of citizens buried at a Minorite monastery in the City of Dordrecht (1275-1572 AD). Rapportage Archeologische Monumentenzorg nr. ,ROB, Amersfoort.

Maresh, M.M., 1955. Linear growth of bones of extremities from infancy through adolescence. A.M.A. American Journal of Disease

of Children, 89: 752-743.

Merbs, C.F., 1992. A new world of infections disease. Yearbook of Physical Anthropology, 35: 3-42.

Merbs, C.F., 1995. Incomplete spondylolysis and healing. Spine 20: 2328-2334.

Molleson, T., 1994. The Eloquent Bones of Abu Hureyra. Scientific American. August 1994: 60-65.

Moore, W.J. and Corbett, M.E., 1983. Dental and alveolar infection. In: Disease in ancient man Hart, G.D. (ed.). Clarke Irwin, Totonto.

Nemeskéri, J., Harsányi, L. & Acsádi, G., 1960. Methoden zur Diagnose des Lebensalters von Skeletfunden. Anthrop. Anz., 24: 70-95.

Niermeyer, J.F., 1944. Delft en Delfland. Hun oorsprong en vroegste geschiedenis, Leiden.

Onisto, N. and Maat, G.J.R., 1995. Demography of a charnel pit in the "Schutterstaat" at Delft from the plague epidemic of 1624 AD. Physical anthropological report CFA, Leiden: 5pp + I.

Oosterbaan, D.P., 1954. Zeven eeuwen. Geschiedenis van het Oude en Nieuwe Gasthuis te Delft, Delft.

Ortner, D.J. and Putschar, W.G.J., 1985. Identification of pathological conditions in human skeletal remains. Smithsonian Institution Press, Contribution nr. 28, Washington.

Ramaer, J.C., 1921. De middelpunten der bewoning in Nederland, voorheen en thans, K.N.A.G. 2de serie XXXVIII 1-38, 174-214.

Rogers, J. and Waldron, T., 1995. A field guide to joint disease in archaelology. J. Wiley and Sons, Chichester.

Salomé, A.J., 1969. Een craniologisch onderzoek van de oude bevolking van Valkenburg-Z.H., Thesis. Spruyt, van Mantgem en De Does, Leiden.

Sjøvold, T., 1975. Tables of the combined method for determination of age at death given by Nemeskéri, Harsányi and Acsádi. Anthrop. Közl., 19: 9-22.

Steinbock, R.T., 1976. Paleopathological Diagnosis and Interpretation. C. Thomas, Springfield.

Stroud, G. and Kemp, R.L. (1993): Cemetries of the Church and Priory of St.Andrew, Fishergate. The Archeology of York; Vol.12: The Medieval Cemetries, Counsel for Britsh Archaeology, York,

pp.175-183.

Trotter, M. and Gleser, G.C., 1952. Estimation of stature from long bones of American Whites and Negroes. American Journal of Physical Anthropology, NS 10: 463-514.

Trotter, M. and Gleser, G.C., 1958. A re-evaluation of estimation of stature based on measurements of stature taken during life and of long bones after death. American Journal of Physical Anthropology, NS 16: 79-123.

Ubelaker, D.H., 1978. Human Skeletal Remains: excavation, analysis and interpretation. Aldine, Chicago.

Van Saase, J.L.C.M., Van Romunde, L.K.J., Cats, A., Vandenbroucke, J.P. and Valkenburg, H.A., 1989. Epidemiology of osteoarthritis: Zoetermeer survey. Comparison of radiological osteoarthritis in a Dutch population with that in 10 other populations. Annals of the Rheumatic Diseases; 48: 271-280.

Van Wieringen, J.C., 1972. Secular changes in growth, 1964-1966: height and weight surveys in The Netherlands in historical perspective. Thesis, Leiden.

Waldron, T., 1994. Counting the Dead. Wiley, Chichester.

William, P.L., Warwick, R., Dyson, M. and Banninster, L.H., 1989. Gray's Anatomy. Churchill Livingstone 37 ed., London.

Wijsenbeek-Olthuis, T., 1987. Achter de gevels van Delft. Bezit en bestaan van rijk en arm in een periode van achteruitgang (1700-1800). Hilversum.

Workshop of European Anthropologists, 1980. Recommendation for age and sex diagnosis of skeletons. Journal of Human Evolution, 9: 517-549.

Wurm, H. and Leimeister, H., 1986. About recommendability and comparability of statements for estimating stature from skeletal remains and about general problems in estimating stature. Gegenbauers morphologisches Jahrbuch, Leipzig; 132: 69-110.

Zimmerman, M.R. and Kelley, M.A., 1982. Atlas of Human Paleopathology. Praeger, New York.

TABLES

Table 1. "OUDE EN NIEUWE GASTHUIS", CITY OF DELFT
1265 - ca.1433 AD (area 1+6)

Number of skeletons observed:	: 52
Horizontal cranial index	: 83.2 (brachyc.)
Percentage of individuals under 20 years	: 21 %
Percentage of individuals over 20 years	: 79 %
Percentage of adult males	: 59 %
Percentage of adult females	: 37 %
Percentage of adults of undetermined sex	: 4 %
Mean age at death of population over 20 yrs	: 45 years
Mean age at death of males over 20 yrs	: 43 years
Mean age at death of females over 20 yrs	: 47 years
Stature of adult males (Breitinger 1937)	: 170.5 cm
Stature of adult males (Trott. & Gl. 1958)	: 171.8 cm
Stature of adult females (Trott. & Gl. 1952)	: 164.4 cm
Maximum femur length of adult males	: 46.0 cm
Maximum femur length of adult females	: 44.2 cm

Table 2. "OUDE EN NIEUWE GASTHUIS", CITY OF DELFT
ca.1433 - 1652 AD (area 7+8)

Number of skeletons observed	:	49
Horizontal cranial index	:	78.5 (mesoc.)
Percentage of individuals under 20 years	:	16 %
Percentage of individuals over 20 years	:	84 %
Percentage of adult males	:	47 %
Percentage of adult females	:	53 %
Percentage of adults of undetermined sex	:	0 %
Mean age at death of population over 20 yrs	:	46 years
Mean age at death of males over 20 yrs	:	43 years
Mean age at death of females over 20 yrs	:	49 years
Stature of adult males (Breitinger 1937)	:	168.9 cm
Stature of adult males (Trott. & Gl. 1958)	:	170.8 cm
Stature of adult females (Trott. & Gl. 1952)	:	162.2 cm
Maximum femur length of adult males	:	45.5 cm
Maximum femur length of adult females	:	43.4 cm

Table 3. SEX OF SKELETONS FROM THE PERIOD 1265-ca.1433 AD (WEA, 1980)

AREA	LEVEL	NUMBER	SEX	PELV.*	W.PELVIS	CAPUT*	W.CAPUT	CRAN.*	W.CRAN	MAND.*	W.MAND
6	2	16	C	.	.	.	.	.	.	.	.
6	2	17	C	.	.	.	.	.	.	.	.
6	3	19	M	1.38	18	1.57	23	0.95	24	1.50	8
6	3	20	M	0.73	19	1.00	26	0.66	18	1.75	8
6	3	22	F	-0.21	19	-1.28	32	-1.37	24	-1.00	8
6	3	26	M	1.47	19	.	.	.	.	1.25	8
6	3	30	F	-1.57	19	-1.06	32	-1.04	24	-1.12	8
6	3	31	M	1.00	19	.	.	.	.	.	.
6	4	34	F	-1.71	14	-1.38	31	-1.50	23	-.87	8
6	4	35	F	-1.58	17	-0.09	32	-0.16	24	0.12	8
6	4	37	M	1.36	19	1.68	32	1.58	24	2.00	8
6	4	41	F	-1.63	19	.	.	.	.	.	.
6	4	42	I	.	.	.	.	.	.	.	.
6	4	47	M	0.76	13	1.59	22	1.50	14	1.75	8
6	5	49	M	1.21	19	.	.	.	.	.	.
6	5	51	M	1.68	19	1.46	32	1.29	24	2.00	8
6	5	55	M	1.28	14	1.44	25	1.70	17	0.80	8
6	5	56	M	1.63	19	.	.	.	.	.	.
6	5	58	F	-1.23	13	.	.	.	.	.	.
6	5	61	M	1.14	14	.	.	0.29	24	.	.
6	6	62	F	-0.73	19	.	.	.	.	-0.12	8
6	6	65	M	.	.	0.59	32	0.41	24	1.12	8
6	6	66	M	0.47	19	1.42	28	1.45	20	1.37	8
6	6	67	M	1.84	19	0.68	32	0.70	24	0.62	8
6	6	71	M	2.00	9	1.21	32	1.08	24	1.62	8
6	6	99	F	-1.52	19	.	.	.	.	.	.

*=Degree of sexualization
W=weight of sex characters
M=Male
F=Female
C=Child
I=Impossible to determine sex

Table 3(cont.) SEX OF SKELETONS FROM THE PERIOD 1265-ca.1433 AD (WEA, 1980)

AREA	LEVEL	NUMBER	SEX	PELV.*	W.PELVIS	CAPUT*	W.CAPUT	CRAN.*	W.CRAN	MAND.*	W.MAND
6	7	84	M	1.77	18	0.53	28	0.35	20	1.00	8
6	8	94	F	-1.21	19	-0.93	32	-1.00	24	-0.75	8
6	8	111	M	1.47	19	1.59	32	1.54	24	1.75	8
6	9	101	F	-0.31	19	-1.21	22	-1.29	24	-1.00	8
6	9	102	F	-1.05	19	-1.46	32	-1.75	24	-0.62	8
6	9	103	C	.	.	.	.	.	.	.	.
6	9	106	M	1.47	19	1.53	32	1.37	24	2.00	8
1	.	78	F	-0.26	16	.	.	.	.	.	.
1	.	95	C	.	.	.	.	.	.	.	.
1	.	109	M	.	.	0.28	32	0.12	24	0.75	8
1	.	110	M	1.91	19	0.78	32	1.00	24	0.12	8
1	.	166	F	-1.28	14	0.31	32	0.25	24	0.50	8
1	.	167	M	0.36	19	.	.	.	.	1.75	8
1	.	169	M	.	.	.	.	.	.	1.37	8
1	.	179	M	1.71	7	.	.	.	.	.	.
1	.	180	F	-1.37	16	0.21	28	0.45	20	-0.37	.
1	.	202	F	-1.38	19	.	.	.	.	.	.
1	.	234	C	.	.	.	.	.	.	.	.
1	.	300	M	1.26	19	.	.	.	.	2.00	8
1	.	330	M	1.47	19	.	.	.	.	1.12	8
1	.	346	I	.	.	.	.	.	.	.	.
1	.	380	F	-0.73	19	-0.86	29	-0.80	21	-1.00	8
1	.	406	M	.00	12	0.68	32	0.58	24	1.00	8
1	.	482a	M	1.47	19	1.84	32	1.87	24	1.75	8
1	.	482b	C	.	.	.	.	.	.	.	.
1	.	520	F	-0.70	10	-0.15	32	-0.20	24	0.00	8

*=Degree of sexualization
W=weight of sex characters

M=Male
F=Female

C=Child
I=Impossible to determine sex

Table 4. SEX OF SKELETONS FROM THE PERIOD ca.1433-1652 AD (WEA, 1980)

AREA	LEVEL	NUMBER	SEX	PELV.*	W.PELVIS	CAPUT*	W.CAPUT	CRAN.*	W.CRAN	MAND.*	W.MAND
7	2	17	C	.	.	.	.	.	.	.	.
7	2	18	C	.	.	.	.	.	.	.	.
7	2	19	M	0.78	19	1.50	32	1.54	24	1.37	8
7	2	20	M	0.00	10	1.63	30	1.59	22	1.75	8
7	3	33	M	.	.	.	.	1.50	18	.	.
7	3	35	M	1.08	12	1.09	32	0.87	24	1.25	8
7	4	39	M	1.89	19	1.53	32	1.50	24	1.62	8
7	4	61	M	0.60	10	0.31	32	0.16	24	1.75	8
7	4	62	C	.	.	.	.	.	.	.	.
7	5	43	F	-1.00	6	-1.68	32	-1.70	24	-1.62	8
7	5	52	F	-1.42	19	-1.53	32	-1.79	24	-0.75	8
7	5	54	F	-1.52	19	-0.75	32	-0.66	24	-1.00	8
7	5	55	M	1.64	14	.	.	.	.	.	.
7	5	67	M	0.42	19	0.78	32	0.54	24	1.50	8
7	5	91	M	1.71	14	0.26	29	0.42	21	1.12	8
7	5	92	F	-1.00	6	.	.	.	.	.	.
7	6	50	C	.	.	.	.	.	.	.	.
7	6	93	M	1.50	18	0.93	15	1.14	7	0.75	8
7	6	94	M	1.50	10	.	.	.	.	1.30	8
8	1	1	F	-1.80	10	.	.	-0.33	18	.	.
8	1	5	F	-0.31	19	.	.	.	.	0.12	8
8	1	8	F	-0.71	14	.	.	.	.	.	.
8	1	9	M	0.84	13	0.96	32	0.70	24	1.75	8
8	2	4	F	-1.60	10	-1.07	26	-1.50	18	-0.12	8
8	2	6	F	-1.14	14	-1.42	19	-1.36	11	-1.50	8

*=Degree of sexualization
W=weight of sex characters
M=Male
F=Female
C=Child
I=Impossible to determine sex

Table 4(cont.) SEX OF SKELETONS FROM THE PERIOD ca.1433-1657 AD (WEA, 1980)

AREA	LEVEL	NUMBER	SEX	PELV.*	W.PELVIS	CAPUT*	W.CAPUT	CRAN.*	W.CRAN	MAND.*	W.MAND
8	2	7	M	0.42	7	.	.	.	.	.	.
8	2	13	F	.	.	.	.	-0.36	19	.	.
8	2	23	F	-0.46	15	-0.52	19	-0.36	11	0.50	8
8	2	28-62	M	1.02	19	.	.	.	.	.	.
8	2	28-64	M	0.28	17	.	.	.	.	1.50	8
8	2	30	F	-1.50	14	.	.	.	.	.	.
8	2	31	F	-1.31	16	.	.	.	.	.	.
8	2	33	M	0.91	12	.	.	.	.	.	.
8	2	34	F	-1.40	9	-0.16	18	0.00	10	-0.37	8
8	2	36	F	-1.38	13	.	.	.	.	.	.
8	3	12	M	1.07	14	1.27	29	1.23	21	1.37	8
8	3	15	F	-0.29	14	.	.	.	.	.	.
8	3	39	M	0.87	16	.	.	.	.	.	.
8	3	41	F	-1.21	14	-1.40	27	-1.42	19	-1.37	8
8	3	42a	M	0.88	18	.	.	.	.	.	.
8	3	42b	M	1.73	19	0.32	31	0.13	23	0.87	8
8	3	44	F	-0.60	10	.	.	.	.	.	.
8	4	55	F	-0.50	16	-1.25	27	-1.36	19	-1.00	8
8	4	45	F	-1.57	14	-1.03	30	-1.29	24	0.00	6
8	5	53	F	-0.85	14	-0.78	23	-1.33	15	0.25	8
8	5	56	F	-0.66	9	.	.	.	.	.	.
8	6	59	F	-0.57	14	.	.	.	.	.	.
8	6	61	M	1.47	19	1.06	32	0.91	24	1.50	8
8	6	62	F	-1.70	10	-1.12	31	-1.21	23	-0.87	8

*=Degree of sexualization
W=weight of sex characters
M=Male
F=Female
C=Child
I=Impossible to determine sex

Table 5. AGE AT DEATH OF SKELETONS FROM THE PERIOD 1265-ca.1433 AD

AREA	LEVEL	NUMBER	SYM	FEM	HUM	SUT	AGE(YRS)	ATTRM1	ATTRM2	ATTRM3	INTERVAL
6	2	16	.	.	.	.	7-8	.	.	.	0
6	2	17	.	.	.	.	15-18	2.33	1.00	.	1
6	3	19	.	.	.	.	20-21	3.33	1.00	1.00	2
6	3	20	3	4	4	1	49.75	5.00	2.66	2.33	4
6	3	22	.	.	.	.	18-19	2.33	2.00	1.00	1
6	3	26	4	2	3	.	62.00	.	.	.	6
6	3	30	.	.	.	.	21-23	3.33	2.00	2.00	2
6	3	31	3	3	5	.	55.00	.	.	.	5
6	4	34	4	4	3	1	59.50	4.00	2.33	.	5
6	4	35	3	4	5	1	50.25	4.33	.	2.66	5
6	4	37	3	2	1	1	41.75	5.33	4.00	3.66	4
6	4	41	3	4	.	.	51-59	.	.	.	5
6	4	42	.	.	.	.	15-18	1.00	1.00	.	1
6	4	47	.	2	4	.	39-48	5.00	4.33	.	4
6	5	49	4	2	3	.	62.00	.	.	.	6
6	5	51	3	3	4	1	48.25	3.00	3.00	2.33	4
6	5	55	.	.	.	.	21-24	3.33	2.33	.	2
6	5	56	.	.	.	.	20-21	.	.	.	2
6	5	58	4	4	.	.	55-63	.	.	.	.
6	5	61	3	3	4	4	55.75	5.00	.	.	5
6	6	62	2	.	2	.	35-44	4.33	3.33	3.33	4
6	6	65	.	.	2	1	32-50	4.00	2.00	.	4
6	6	66	2	1	2	4	38.50	5.66	5.66	3.00	3
6	6	67	3	.	1	2	45.67	4.00	2.33	1.00	4
6	6	71	.	2	.	4	40-49	.	4.00	4.00	4
6	6	99	4	1	3	.	58.67	.	.	.	5

SYM= phase of symphaseal face (WEA, 1980) ATTR= degree of attrition after Brothwell (1981)
FEM= " " femoral spongiosa (" ") M = molar
HUM= " " humeral " (" ") SUT = phase of sutural closure (WEA, 1980)

Table 5(cont.) AGE AT DEATH OF SKELETONS FROM THE PERIOD 1265-ca.1433 AD

AREA	LEVEL	NUMBER	SYM	FEM	HUM	SUT	AGE(YRS)	ATTRM1	ATTRM2	ATTRM3	INTERVAL
6	7	84	3	2	3	2	49.25	.	3.33	.	4
6	8	94	4	2	4	1	56.75	2.33	2.33	.	5
6	8	111	1	1	2	1	22-24	2.66	2.00	.	2
6	9	101	.	.	.	.	18-20	3.00	2.00	.	1
6	9	102	.	.	.	.	18-19	2.00	1.00	.	1
6	9	103	.	.	.	.	8-9	.	.	.	0
6	9	106	3	2	3	2	49.25	2.66	2.00	.	4
1	.	78	4	4	.	.	55-63	5.00	4.00	2.33	5
1	.	95	.	.	.	.	5-8	.	.	.	0
1	.	109	.	.	.	1	23-40	.	4.33	.	4
1	.	110	3	2	2	4	51.75	4.00	3.00	.	5
1	.	166	.	.	.	.	21-23	2.33	2.00	1.00	2
1	.	167	2	2	4	.	41.33	.	.	.	4
1	.	169	.	.	.	.		.	.	.	.
1	.	179	4	3	.	.	52-60	.	.	.	5
1	.	180	4	4	4	1	60.00	.	.	.	6
1	.	202	1	1	.	.	28-36	.	.	.	.
1	.	234	.	.	.	.	12-18	.	.	.	1
1	.	300	1	3	2	.	36.00	2.66	2.00	1.00	3
1	.	330	3	2	3	.	51.00	.	3.00	.	5
1	.	346	.	.	.	.		.	.	.	.
1	.	380	.	.	.	.	20-21	5.33	2.33	.	2
1	.	406	.	4	.	1	36-52	.	.	.	.
1	.	482a	1	1	1	1	23.00	5.00	4.00	2.00	2
1	.	482b	.	.	.	.	13-15	.	.	.	1
1	.	520	.	4	4	2	61.67	4.00	4.00	.	6

SYM= phase of symphaseal face (WEA, 1980) ATTR= degree of attrition after Brothwell (1981)
FEM= " " femoral spongiosa (" ") M = molar
HUM= " " humeral " (" ") SUT = phase of sutural closure (WEA, 1980)

Table 6. AGE AT DEATH OF SKELETONS FROM THE PERIOD ca.1433-1652 AD

AREA	LEVEL	NUMBER	SYM	FEM	HUM	SUT	AGE(YRS)	ATTRM1	ATTRM2	ATTRM3	INTERVAL
7	2	17	.	.	.	.	14-18	.	.	.	1
7	2	18	.	.	.	.	8-13	.	.	.	0
7	2	19	3	2	3	1	45.75	5.33	3.00	1.00	4
7	2	20	.	.	2	1	32-50	5.00	4.00	2.00	4
7	3	33	1	.	.	1	19-28	3.33	1.00	.	2
7	3	35	.	3	.	3	48.57	5.00	4.00	.	4
7	4	39	3	3	4	3	54.00	5.00	4.00	.	5
7	4	61	.	.	.	2	30-60	5.33	4.33	2.66	4
7	4	62	.	.	.	.	10-14	.	.	.	1
7	5	43	2	.	.	2	32-41	.	.	.	4
7	5	52	1	2	.	1	27.00	3.33	3.33	2.00	2
7	5	54	4	1	2	2	56.00	3.33	3.00	1.00	5
7	5	55	.	2	2	.	34-43	.	.	.	.
7	5	67	4	1	2	3	58.00	4.00	3.00	3.00	5
7	5	91	.	1	1	2	27.00	.	4.00	3.00	2
7	5	92	.	1	3	.	31-40	.	.	.	3
7	6	50	.	.	.	.	9-10	.	.	.	0
7	6	93	.	3	2	1	44.33	5.00	4.00	4.00	4
7	6	94	.	1	.	.	23-25	4.00	2.66	2.00	2
8	1	1	4	3	3	2	61.00	.	.	.	6
8	1	5	1	1	2	.	29.00	3.33	1.00	.	2
8	1	8	.	.	.	.	18-19	.	.	.	1
8	1	9	4	4	4	2	63.25	4.33	.	.	6
8	2	4	.	4	.	4	62-71	.	.	.	.
8	2	6	2	2	.	1	31.67	2.33	2.00	1.00	3
8	2	7	4	3	.	.	52-60	.	.	.	5

SYM= phase of symphaseal face (WEA, 1980) ATTR= molar attrition after Brothwell (1981)
FEM= " " femoral spongiosa (" ") M = molar
HUM= " " humeral " (" ") SUT = phase of sutural closure (WEA, 1980)

Table 6 (cont.). AGE AT DEATH OF THE SKELETONS FROM THE PERIOD ca.1433-1652 AD

AREA	LEVEL	NUMBER	SYM	FEM	HUM	SUT	AGE(yrs)	ATTRM1	ATTRM2	ATTRM3	INTERVAL
8	2	13	.	.	.	4	40-80	.	.	.	.
8	2	23	.	1	2	1	29.00	3.00	2.33	1.00	2
8	2	28-62	.	.	.	.	24.00	.	.	.	2
8	2	28-64	.	1	1	.	19-28	4.33	2.66	1.00	2
8	2	30	.	.	.	.	18-21	.	.	.	.
8	2	31	4	3	4	.	67.00	.	.	.	6
8	2	33	.	.	.	.		.	.	.	.
8	2	34	4	4	4	1	60.00	5.00	2.66	2.66	6
8	2	36	.	.	.	.	21-24	.	.	.	2
8	3	12	.	1	3	1	31.33	5.33	1.00	.	3
8	3	15	.	4	4	.	62-71	.	.	.	.
8	3	39	2	1	1	.	27.67	.	.	.	2
8	3	41	.	3	4	4	57.00	.	4.00	2.33	5
8	3	42a	3	3	.	.	48-56	.	.	.	.
8	3	42b	4	1	2	2	56.00	.	.	.	5
8	3	44	.	2	.	.	35-55	.	.	.	.
8	4	55	.	4	.	4	62-71	.	.	.	.
8	4	45	.	4	.	1	36-52	4.00	3.00	.	4
8	5	53	.	.	.	.	18	2.33	1.00	.	1
8	5	56	.	.	.	.	.	.	.	.	.
8	6	59	.	4	4	.	62-71	.	.	.	.
8	6	61	4	2	2	4	62.00	5.66	5.66	.	6
8	6	62	.	.	.	2	30-60	5.00	3.00	2.00	4

SYM= phase of symphaseal face (WEA, 1980)
FEM= " " femoral spongiosa (" ")
HUM= " " humeral " (" ")
SUT= " " sutural closure (" ")
ATTR= degree of attrition after Brothwell (1981)
M= molar

Table 7. AGE AT DEATH DISTRIBUTION

INTERVAL (years)	1265-ca.1433 AD		ca.1433-1652 AD	
	N.	%	N.	%
0-10	3	6.4	2	5.3
10-20	7	14.9	4	10.5
20-30	8	17.0	10	26.3
30-40	3	6.4	3	7.9
40-50	11	23.4	8	21.1
50-60	11	23.4	6	15.8
60-70	4	8.5	5	13.2
Not classifiable	5	-.-	11	-.-

Table 8. ADULT STATURE (cm), 1265-ca.1433 AD

AREA	LEVEL	NUMBER	TRGL	TRGL.COR	BREIT
6	2	16	.	.	.
6	2	17	.	.	.
6	3	19	.	.	.
6	3	20	172.6	171.4	170.2
6	3	22	.	.	.
6	3	26	168.1	166.2	166.5
6	3	30	173.5	.	.
6	3	31	178.1	176.6	175.8
6	4	34	155.4	153.7	.
6	4	35	157.4	156.2	.
6	4	37	166.3	165.6	168.2
6	4	41	157.8	156.3	.
6	4	42	.	.	.
6	4	47	172.1	171.3	169.7
6	5	49	171.1	169.2	169.0
6	5	51	162.0	160.9	163.2
6	5	55	173.1	.	171.2
6	5	56	178.3	.	172.8
6	5	58	159.3	157.6	.
6	5	61	175.5	173.9	173.2
6	6	62	169.6	169.1	.
6	6	65	172.0	171.4	172.4
6	6	66	182.1	181.6	179.6
6	6	67	181.1	180.1	177.8
6	6	71	.	.	.
6	6	99	172.5	170.8	164.1
6	7	84	171.6	170.5	170.6
6	8	94	158.4	156.7	.
6	8	111	169.2	.	170.0
6	9	101	.	.	.
6	9	102	146.9	.	.
6	9	103	.	.	.
6	9	106	177.7	176.5	176.8
1	.	78	153.8	152.1	.
1	.	95	.	.	.
1	.	109	169.6	169.5	166.8
1	.	110	175.9	174.6	173.6
1	.	166	160.4	.	.
1	.	167	167.8	167.1	168.4
1	.	169	.	.	.
1	.	179	169.6	168.0	169.8
1	.	180	165.4	163.6	.
1	.	202	168.1	168.0	.
1	.	234	.	.	.
1	.	300	169.7	169.3	170.6
1	.	330	174.6	173.4	173.4
1	.	346	.	.	.
1	.	380	176.4	.	.
1	.	406	157.2	156.3	159.5
1	.	482a	168.6	.	168.6
1	.	482b	.	.	.
1	.	520	173.5	171.6	.

TRGL Trotter & Gleser BREIT= Breitinger COR= corrected for age

Table 9. ADULT STATURE (cm), ca.1433-1652 AD

AREA	LEVEL	NUMBER	TRGL	TRGL.COR	BREIT
7	2	17	.	.	.
7	2	18	.	.	.
7	2	19	168.1	167.2	164.0
7	2	20	.	.	.
7	3	33	.	.	.
7	3	35	176.4	175.3	172.9
7	4	39	170.6	169.2	171.7
7	4	61	171.7	170.8	166.0
7	4	62	.	.	.
7	5	43	.	.	.
7	5	52	160.3	.	.
7	5	54	159.7	158.2	.
7	5	55	176.0	175.5	172.2
7	5	67	177.3	175.6	175.3
7	5	91	168.0	.	168.7
7	5	92	165.2	164.8	.
7	6	50	.	.	.
7	6	93	167.5	166.7	169.1
7	6	94	172.8	.	170.0
8	1	1	167.6	165.8	.
8	1	5	171.7	.	.
8	1	8	.	.	.
8	1	9	172.0	170.1	171.8
8	2	4	.	.	.
8	2	6	157.8	157.7	.
8	2	7	169.2	167.7	167.8
8	2	13	164.5	162.7	.
8	2	23	160.8	.	.
8	2	28-62	165.0	165.1	164.5
8	2	28-64	172.3	.	168.0
8	2	30	154.8	.	.
8	2	31	167.0	164.8	.
8	2	33	168.6	.	167.0
8	2	34	153.4	151.6	.
8	2	36	175.6	.	.
8	3	12	168.8	168.7	166.9
8	3	15	170.6	168.4	.
8	3	39	180.6	.	175.1
8	3	41	154.9	153.3	.
8	3	42a	164.7	163.4	167.5
8	3	42b	167.4	165.8	165.2
8	3	44	155.5	154.6	.
8	4	55	153.6	151.5	.
8	4	45	162.5	161.6	.
8	5	53	.	.	.
8	5	56	160.9	.	.
8	6	59	174.1	171.9	.
8	6	61	168.4	166.5	166.3
8	6	62	153.4	152.5	.

TRGL= Trotter & Gleser, BREIT= Breitinger
COR= corrected for age

Table 10. MAXIMAL FEMORAL LENGTH (Knussmann, 1988)

	Mean (cm)	N	s.d. (cm)
1265-ca.1433 AD:			
males	46.0	20	2.6
females	44.2	11	2.7
ca.1433-1652 AD:			
males	45.5	16	1.9
females	43.4	17	2.7
1265-1652 AD:			
males	45.8	36	2.3*
females	43.7	28	2.7*

* Student's two-sample test: p=.001.

Table 11. DENTAL STATUS / TOTAL COUNT (N=number)

	1265-ca.1433 AD	ca.1433-1652 AD
N erupted	1198	926
N not devel./-erup	11	11
N supernumerary	3	0
AM loss	173	152
PM loss	40	76
N inspected	762	527
PM alv loss	133	129
N carious	58	65
N abscesses	63	38

Table 12. TOTAL COUNT AND FREQUENCY OF MAIN PATHOLOGIC CHANGES AND ANOMALIES IN ADULTS 1265-ca.1433 AD

Pathologic change	Number of individuals affected		Number of individuals observed
Healed fractures	7		NA
Healed skull wounds	3	(9%)	35
Spondylolysis L5	1	(2%)	50
Maxillary sinusitis	1		NA
Periostitis, of both legs	1	(2%)	47
" , general	1	(2%)	50
Osteomyelitis of one leg	1	(3%)	39
Tuberculosis	1	(2%)	50
Rickets	1	(2%)	50
Osteoma, cranial	1	(3%)	35
Tumor metastases	2	(4%)	5
Scheuermann's disease	1	(2%)	50
DISH	4	(8%)	50
Multiple enthesopathies	10	(20%)	50
Sutura metopica	2	(6%)	35
Fontanella minor, persisting	1	(3%)	35
Double os bregmaticum	1	(3%)	35
Sacralization L5	1	(2%)	50
Lumbarization S1	1	(2%)	50
6th Lumbar vertebra	1	(2%)	50
Spina bifida occulta, sacrum	4	(9%)	44
Foramen olecrani	4	(9%)	47
Foramen sternale	2	(5%)	37
Squatting facets, femoral	1	(2%)	46

NA= not applicable

Table 13. FREQUENCY OF DEGENERATIVE ARTHROPATHIES IN ADULTS 1265-ca.1433 AD

Arthropathy	Number of individuals affected		Number of individuals observed
Vertebr. osteophytosis	19	(38%)	50
Vertebr. osteoarthritis	8	(16%)	50
Perif. osteoarthritis	5		NA

NA= not applicable

Table 14. TOTAL COUNT AND FREQUENCY OF MAIN PATHOLOGIC CHANGES AND ANOMALIES IN ADULTS ca.1433-1652 AD

Pathologic change	Number of individuals affected		Number of individuals observed
Healed fractures	5		NA
Periostitis of one leg	3	(9%)	32
Suppurative arthritis	2	(4%)	49
Tuberculosis	1	(2%)	49
Cribra orbitalia	1	(3%)	30
Osteoma, cranial	2	(7%)	30
Tumor of arch C2	1	(2%)	48
Osteochondritis diss.	3	(6%)	49
DISH	9	(20%)	46
Multiple enthesopathies	4	(8%)	49
Sacralization L5	3	(8%)	40
Spina bifida occulta	2	(5%)	40
Foramen olecrani	3	(7%)	45
Foramen sternale	1	(5%)	22

NA= not applicable

Table 15. FREQUENCY OF DEGENERATIVE ARTHROPATHIES IN ADULTS ca.1433-1652 AD

Arthropathy	Number of individuals affected		Number of individuals observed
Vertebr. osteophytosis	21	(44%)	48
Vertebr. osteoarthritis	7	(15%)	48
Perif. osteoarthritis	17		NA

NA= not applicable

LEGENDS

Fig. 1: Town plan of the inner City of Delft. The location of the infirmary is indicated in black. The shaded area indicates city size in 1251 AD.

Fig. 2: Many intersecting burials and the foundations of the oldest choir of the chapel.

Fig. 3: Three of the oldest burials in the cemetery. The bodies were interred without a coffin.

Fig. 4: The "Oude en Nieuwe Gasthuis": plan of the chapel and some related structures. Drawing: H.A. Robbers.
Legenda:
1. Foundation of period 1 (c. XIIIc)
2. Foundation of period 2 (c. AD 1300)
3. Foundation of period 3 (c. XIVB)
4. Foundation of period 4 (c. AD 1400)
5. Foundation of period 5 (c. XVb)
6. Foundation of period 6 (c. XVB)
7. Cess-pit
8. Trench of a looter.

Fig. 5: Distribution of the degree of sexualization of the pelvises. Hyperfeminine= -2, hypermasculine= +2.

Fig. 6: Age at death distributions for both periods.

Fig. 7: Heavy unilateral calculus deposits probably due to hemi-facial paralysis, in a female of ca. 62 years (nr. 1-520).

Fig. 8: A healed fracture at the distal articular surface of a left radius in a 55-63 years old female (nr. 6-5-58).

Fig. 9: Two cases of collapsed vertebras and resulting angular kyphosis due to tuberculosis. In the left case from

the Early Period it is the lumbar vertebras which are collapsed (male, 36 years old, nr. 1-300). In the right case from the "Late Period" it is the thoracic vertebras (male, 30-60 years old, nr. 7-4-61). Note abscess cavities lacking bony reaction.

Fig.10: Scheuermann's disease in a spine of a 46 years old male (nr. 6-6-67). The thoracic vertebras are affected in particular. The height of the bodies varies.

Fig.11: Suppurative arthritis of the left hip joint in a 19-28 years old male (nr. 8-2-28,64). Note the lytic bone reaction due to the infection.

Fig.12: Osteochondritis dissecans in a 62-71 years old female (nr. 8-6-59). The distal joint surface of the right and left humerus and the right head of the radius are affected. Note the punched-out lesions after fragmentation and disruption of articular cartilage.

Fig.13: Periferal osteoarthritis (pOA) of the right hip joint in a 63 years old male (nr. 8-1-9). Pitting of the acetabulum, and eburnation of the femur head can be seen.

Fig.14: Age at death distribution of 57 buried plague victims at the Maria Magdalena Convent.

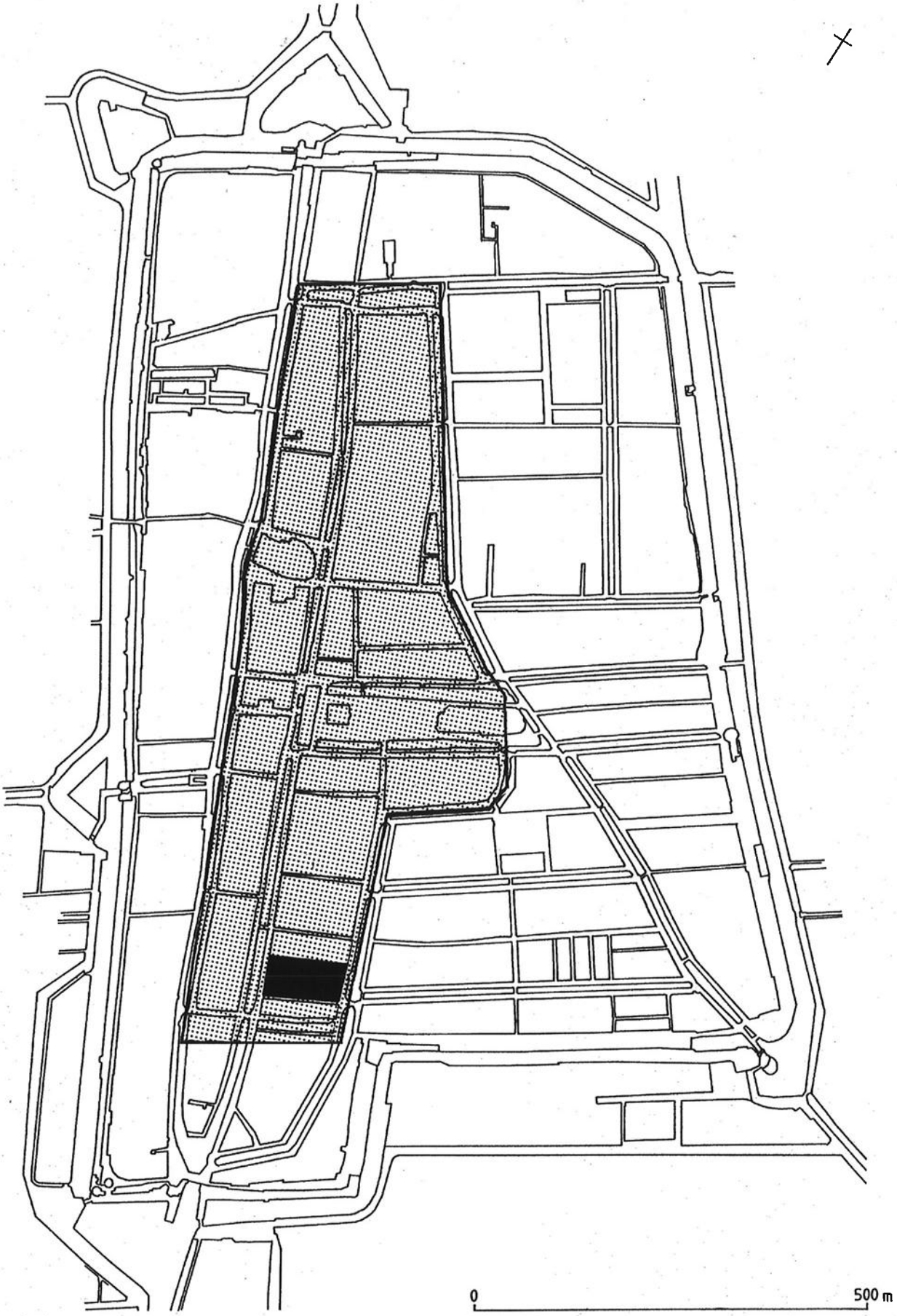


Fig 1

Fig 2

Fig 3

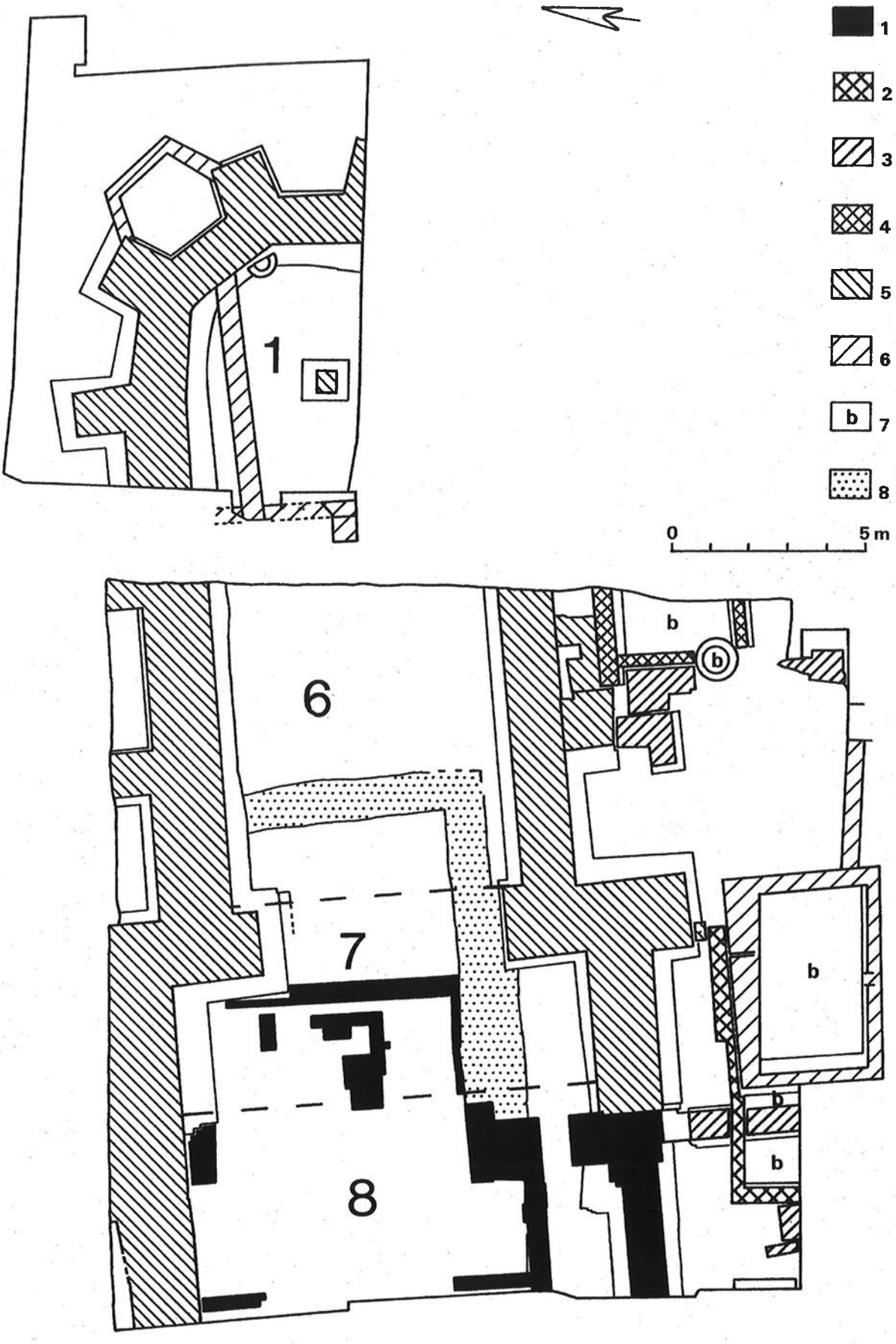
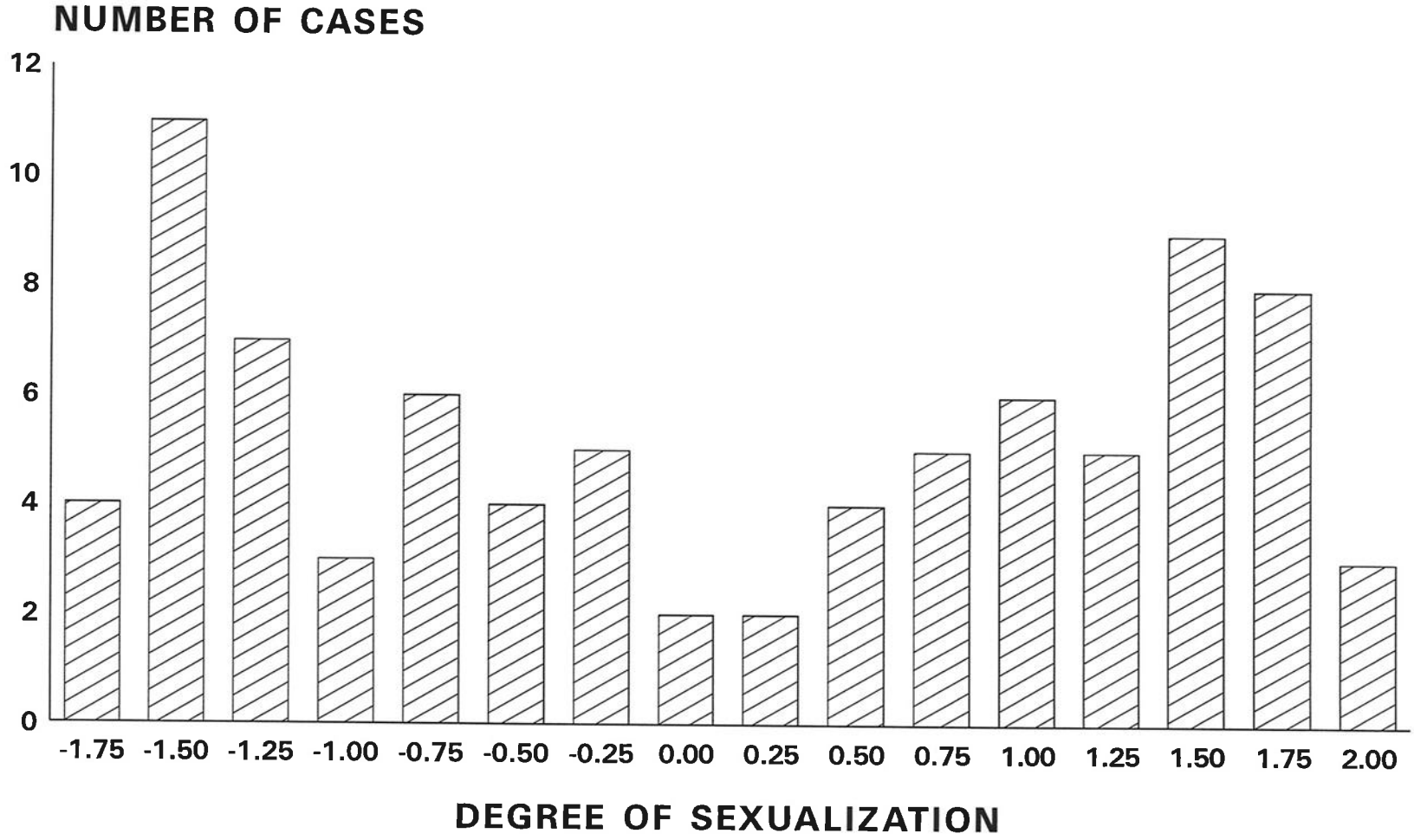


Fig 4

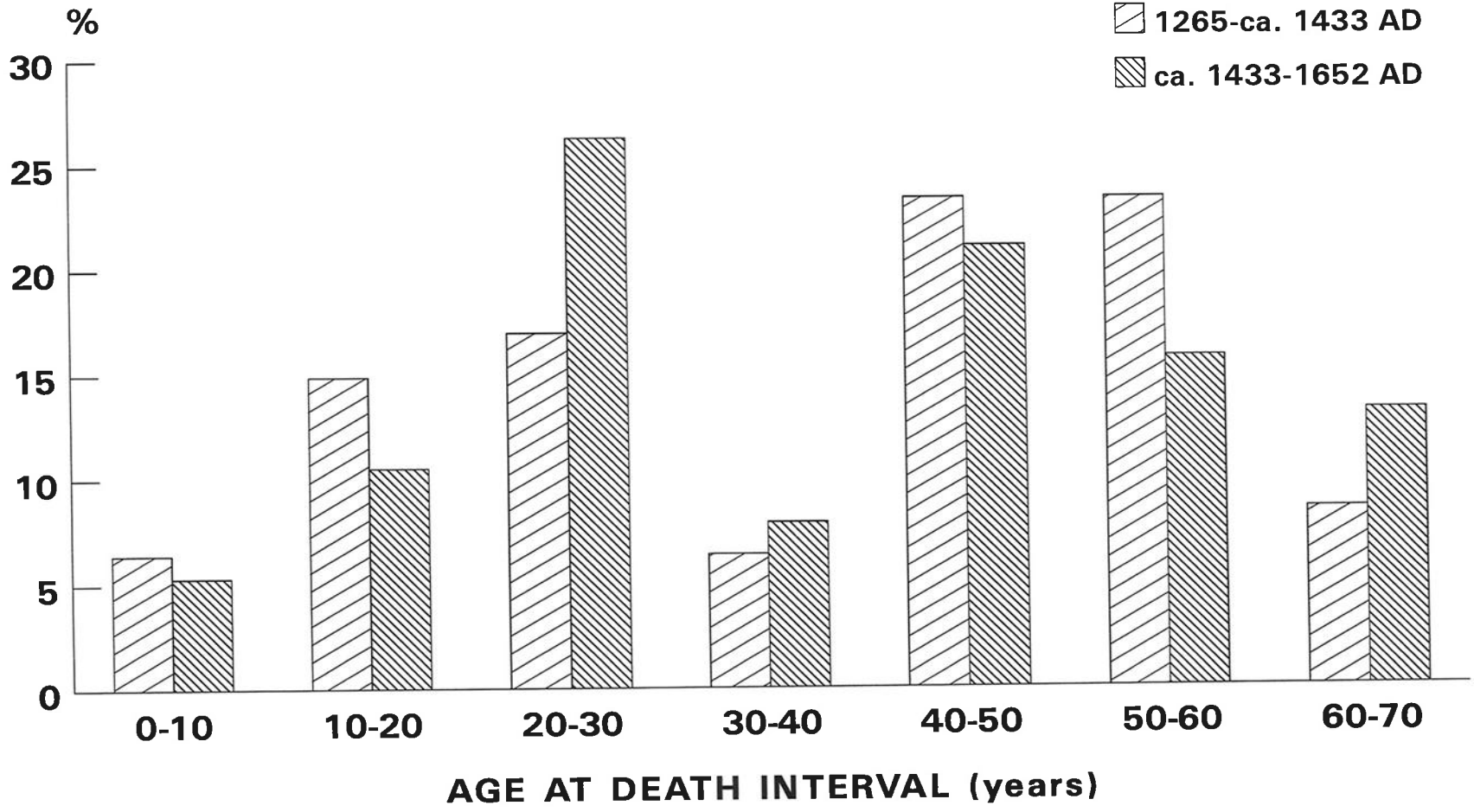
DELFT, "OUDE EN NIEUWE GASTHUIS"
DISTRIBUTION OF THE PELVIC DEGREE OF SEXUALIZATION
1265-1652 AD



Degree calculated after WEA, 1980
Fig. 5

DELFT, "OUDE EN NIEUWE GASTHUIS"

AGE AT DEATH DISTRIBUTION
1265-1652 AD



Ages after WEA, 1980
Fig. 6

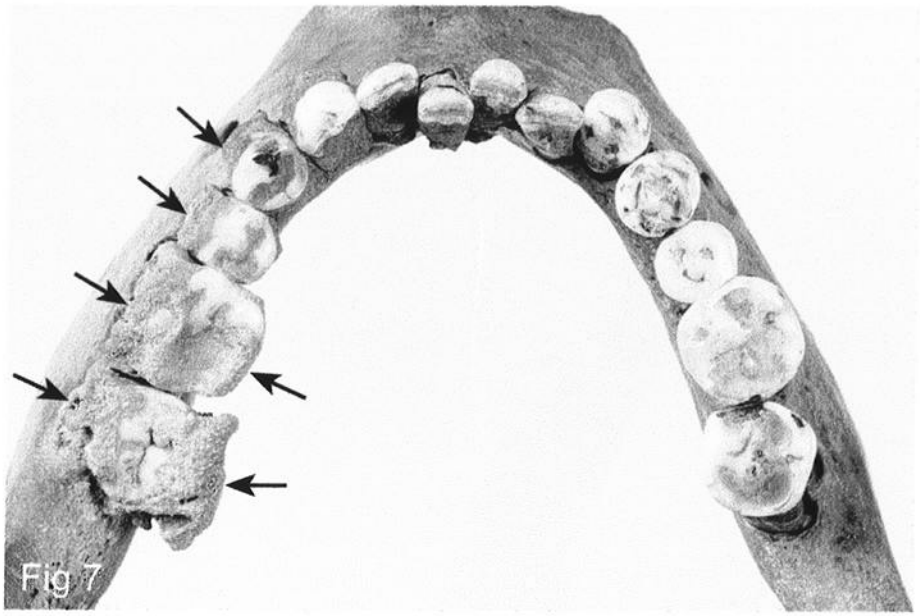


Fig 7

Fig 8

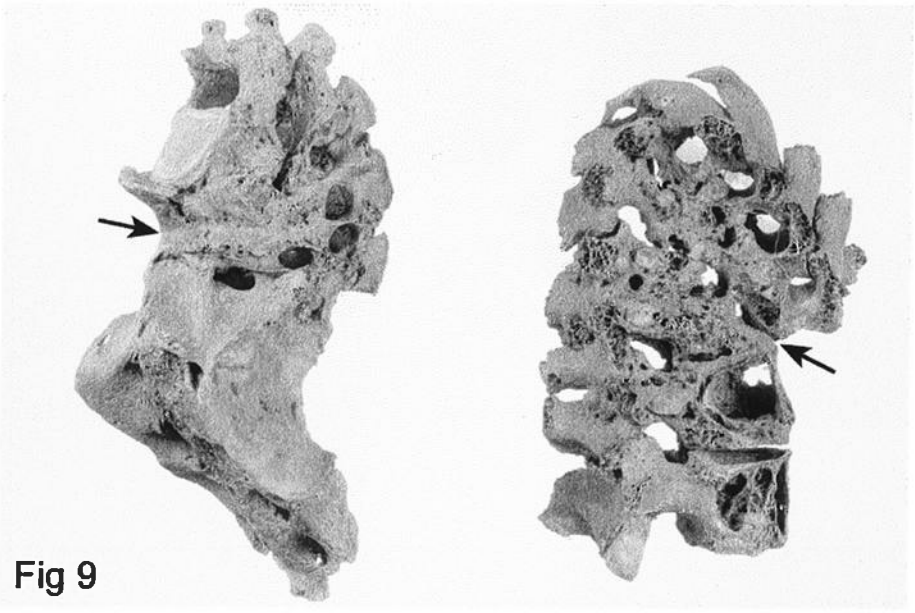
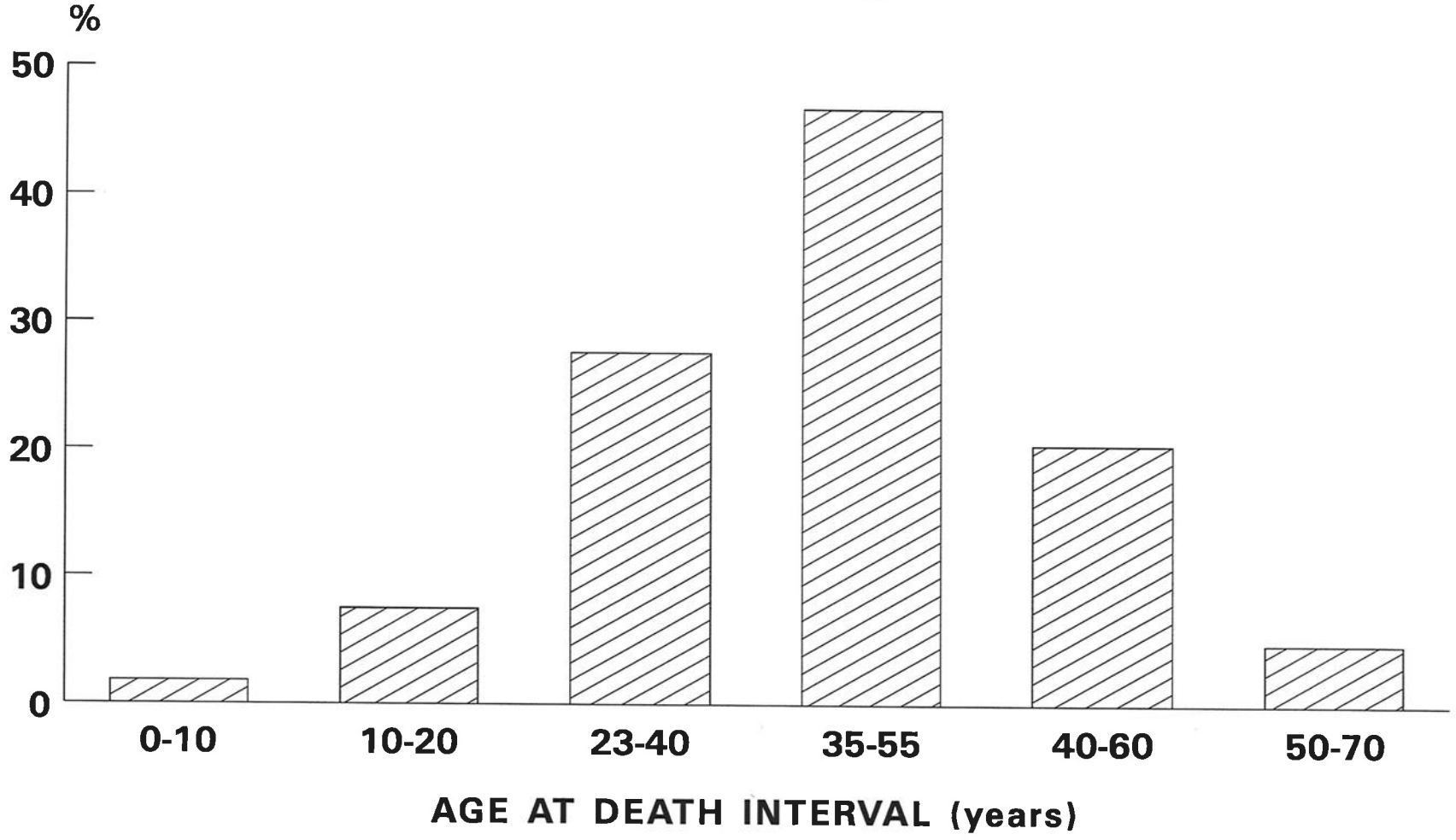


Fig 9

DELFT, MARIA MAGDALENA CONVENT

SKELETONS FROM A CHARNEL PIT FOR PLAGUE VICTIMS

1st HALF OF 17th CENTURY



Age estimated from epiphyseal union status and spongiosa structure of proximal femur (WEA, 1980)
Onisto and Maat, 1995; N= 57
Fig. 14