Peacock Elizabeth Ellen (Orcid ID: 0000-0002-2894-720X)

The concealed interment of a first-trimester foetus in Gällared Parish Church (1831), Sweden: Age-estimation and reconstructed taphonomy

Emma Maltin[1], Gordon Turner-Walker[2], Stina Tegnhed[3], and Elizabeth E. Peacock[4]

[1] Department of Archaeology and Classical Studies, Stockholm University, SE-106 91 Stockholm, Sweden. Email: emma.maltin@ark.su.se

[2] Graduate School of Cultural Heritage Conservation, National Yunlin University of Science and Technology, 123 University Road Sector 3, Douliou, 640 Yunlin, Taiwan. Email: gordontw@yuntech.edu.tw

[3] Cultural Environment Halland, Halland Museum of Cultural History, Tollsgatan 7, SE-302 32 Halmstad, Sweden. Email: Stina.Tegnhed@kulturmiljohalland.se

[4] Department of Archaeology and Cultural History, NTNU University Museum, Norwegian University of Science and Technology (NTNU), NO-7491 Trondheim, Norway. Email: elizabeth.peacock@ntnu.no

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1002/oa.2946

Abstract

In 2015, during architectural restoration works on the parish church (1831) in Gällared, Sweden, a small wooden box was discovered beneath the floorboards. Unaware of the possible significance of the box and its contents, workers on site removed its lid revealing a piece of folded cloth. This was later found to be wrapped around fragments of human foetal remains. Although largely forgotten now, concealed interment of foetuses in, and around, churches were formally a well-known custom in Nordic Europe. Osteological and archaeological examinations of these are rare because the containers are recognised as a form of mortuary ritual and thus are neither removed from the church nor investigated for obvious ethical reasons. The occasion of this providentially found concealed interment provided an opportunity to undertake a systematic study of the coffin and its contents prior to it being reinterred. This paper focuses on the foetal remains: their identification, assessment of age at death, and the taphonomic circumstances leading to their preservation, as well as the broader insights this funerary behavior sheds on the meanings of personhood, infant death and grief. Visual and microscopic analysis conclude the foetus was miscarried in its first trimester, in week nine, making it possibly one of the youngest ever reported to be recovered from an archaeological context. Examination of the skeletal elements highlights both the difficulty in ageing early-stage archaeological foetal skeletons and the paucity of comparative foetal bone-size material. The onset of ossification and the development of the mandible as ageing indicators show significant potential. Detailed examination of the wooden coffin, cotton burial shroud and insect fauna, together with an understanding of foetal body chemistry and the circumstances of interment, support the hypothesis that the bones' survival was facilitated by a process of natural mummification prior to becoming fully skeletonized by insects.

KEYWORDS*:* early infant mortality; miscarriage; foetal body chemistry; natural mummification; social bioarchaeology

1 INTRODUCTION

In late autumn 2015, architectural restoration works on the stone parish church (1831) located in the village of Gällared in rural southwest Sweden (Figure 1) were undertaken to comply with disabled access. When the wooden floor in the SW part of the nave was removed, the builders discovered a small closed wooden box in the crawl space just beneath the floorboards (Figure 2a) (Tegnhed, 2016). This well-ventilated crawl space was filled with building rubble (stone, masonry mortar and plaster) and fine sandy soil as well as the remains of the foundation walls of the earlier medieval stone church. The workers stated there were no gaps in the floor in the vicinity of the find, and that the box was placed so far under the floor that it was most likely concealed when the original floor was laid (Tegnhed, 2016:8-9) during the autumn (Karlsson, 1982) when the earlier church was rebuilt in 1831. The workers were unaware that the box could be a concealed interment. The church has no crypt, and there was never a custom of inhumations inside the church (U. Andersson, personal communication, 2020). When recovered, the box was intact and sealed. Assuming it was empty, the workers removed the lid, which proved easy because the nails had rusted through. Inside the box was a piece of folded cloth, which, upon closer examination later, was revealed to be wrapped around small fragments of what were suspected to be human foetal[1] skeletal remains which were adhering to the cloth (Figure 2b). It then became clear that the box was a coffin and the textile a burial shroud.

Archaeological and antiquarian investigations of churches and cemeteries in Nordic Europe have repeatedly found evidence of the practice of interring coffined foetuses inside churches or within the walls of the consecrated graveyard surrounding churches (Jonsson, 1999 & 2006; Lipkin et al., 2018). This custom dates from the introduction of Christianity in the early medieval period and Canon Law which dictated that unbaptised adults and children (amongst others of uncertain baptismal status such as suicides, convicted thieves, homosexuals, assassins, criminals, strangers and murderers) were not entitled to burial in consecrated ground. In the Christian world, with the denial of burial in sacred ground, and the associated tragic inability of unbaptised babies to find peace and enter the kingdom of heaven, a range of alternative burial customs developed (Jonsson, 2006; Hagberg, 2015). These included: concealed burial (with or without a coffin) in the bottom of a newly dug grave or placed together in the grave of a recently deceased individual, burial in a small coffin within the church or cemetery walls or interment in children's burial grounds such as those in Scotland (McCabe, 2016) and the *cillini* in Ireland (Murphy 2011). The Reformation gradually led to a progressively more tolerant attitude regarding Canon Law, but the problem of Christian burials of miscarriages remained critical in Nordic Europe, even into the early 20th century. As a consequence, concealed foetal burials continued into modern times in this region. Burial in a small wooden or cardboard coffin - makeshift, carefully crafted or procured - was wide-spread and well known - especially in rural areas - and existed in parallel with official religious practice in modern Nordic Europe (Bø, 1960; Hagberg, 2015; Lipkin et al., 2018). These concealed interments were facilitated by family members, midwives, gravediggers, sextons or others within the community (Bø, 1960). In response to a questionnaire Bø sent out to parishes in Norway and Sweden in 1953, one builder commented that he had found hundreds of such containers in the course of his work.

Generally, when small coffin-like containers (*fosterkista* (Swedish), *fosterskrin* and *aborteske* (Norwegian) and *sikiön arkku* (Finnish)) have been found within a church or cemetery walls, they have been recognised as such and not opened. If opened, the bones have been frequently found to have deteriorated completely leaving only the packing material (Bø,

[1] In this article, the medical definition of a foetus as an unborn baby from the eighth week after fertilisation until birth is used. Foetal rather than gestational age is used throughout unless otherwise specified.

1960). In the past, the fate of many of these small containers was to be discarded or burned. Rarely, have they entered a museum collection (Magnussen, 2005; Londos, 1995) or had their contents studied; whereas, some have been reinterred. Despite enduring into the 20th century, this tradition is no longer in living memory. An informal survey carried out in 2016, of 19 osteoarchaeologists and archaeologists representing universities, museums and forensic institutes in Scandinavia and the UK found that many respondents encountered graves with small children, infants or foetuses both in cemeteries and inside churches. Few were familiar with the tradition of concealed coffin burial of small fetuses within churches or church walls (Peacock et al. 2020).

There are numerous osteological studies of near full-term foetuses or stillborn burials recovered from archaeological contexts (e.g. Halcrow et al. 2018; Mays et al., 2017 and references therein). However, reported studies of early-stage foetal (first and early second trimester) burials are rare. A combination of factors including small physical size, low bone mineralisation and the nature of the depositional environment and depositional context lead to the low survival and recovery potential of these remains. There are anecdotal references to several early-stage foetal burials but none has been formally published. A closed wooden box discovered in a wall of Bringetofta Parish Church (1754), Sweden contained the wrapped skeletal remains of what, on initial analysis, was identified as a rodent but later recognised to be a 15-20 week-old human foetus (Londos, 1995). Prior to restoration at Urnes Stave Church (1130) in western Norway fifteen 18-19th century coffins were disinterred from beneath the floorboards. Examined on site by an osteoarchaeologist prior to being reinterred small coffins containing one first-trimester (2-3 foetal months) and two second-trimester foetuses (16-17 foetal weeks and 21 foetal weeks) were found between the adult coffins (Sellevold, 2008). No formal osteological reports were published. The skeletal remains of a foetus dating from the 9-12th century were discovered at a Late Woodland (Pre-Columbian) ossuary and occupation site in Ottawa County, Ohio, USA. This has been previously cited as the only first-trimester foetus published from an archaeological context (e.g., Halcrow et al., 2018:86). The Libben foetus was estimated to be "16 foetal weeks gestation" (Lovejoy, personal communication, 16 April 2020; Zirkle & Lovejoy, 2019:Fig. 5) making it a second-trimester foetus based upon a comparison of the specimen's iliac dimensions with those reported by Fazekas & Kósa (1978). Once again, these findings were never formally reported in the literature.

The casual opening of the Gällared coffin presented an unprecedented opportunity both for a systematic study of it and its contents and to explore the complex status in Christian societies of the unborn foetus and motherhood in 19th-century Nordic Europe. This article presents an osteological study of the foetal remains, including identification and estimation of age at death. By necessity, this raises the issue of the applicability of data from Fazekas & Kósa and other researchers to very young foetal remains (Sanders, 2009 and references therein). Further, it proposes a timeline and possible taphonomic trajectory that may account for the foetus' preservation by initial natural mummification, followed by skeletonization by saprophagous insects, which all contribute to its survival potential. Nevertheless, it was the careful circumstances of its concealment and the social forces that drove its post-mortem treatment that led to its ultimate discovery.

MATERIALS AND METHODS

The coffin was examined by visual inspection and measurements taken, together with overview photographs showing construction. Neither the coffin, nor its contents received any cleaning or other invasive treatment post-retrieval. The shroud and enclosed fragmentary insect remains and frass (chewed wood and droppings) were all studied using visual inspection and optical microscopy. When removed from the coffin for examination, all the small bones were adhering to the interior surface of the folded shroud. They were carefully

separated and examined by eye and using low power optical microscopy. Only those bones were available for analysis; if there had been any loose bones, they must have been lost during the handling of the coffin and its contents on site. Each skeletal part was macroscopically and microscopically examined and photographed to register morphological characteristics and state of preservation. Following the initial examination, age at death of the retrieved skeletal elements was estimated through assessment of the size and morphology of the bones, and of the appearance and fusion of major centers of ossification in comparison with current data on embryonic and foetal development (e.g. Noback & Robertson, 1951; O'Rahilly & Gardner, 1972). Identified skeletal elements were measured following standardized guidelines for age-at-death estimation of immature human remains (e.g., Schaefer et al., 2009). Metric data on foetal bone measurements is provided by Fazekas & Kósa (1978) and these are commonly used to estimate age at death of foetuses recovered from archaeological contexts. These were assessed for applicability in this study.

RESULTS

The Human Foetal Remains

Upon careful unfolding an examination of the shroud, the skeletal remains were found in their approximate anatomical arrangement, adhering to one another and to the shroud with dried connective tissue. This fixed arrangement greatly aided the identification of the remains.

The foetal remains constitute several (n=23) tiny bones, with the longest 7.3 mm (Figure 3). These include: ribs from both sides of the body (9 from the right and 8 from the left), the left and right halves of the unfused mandible, the right humerus, an unidentified long bone and several pieces of paper-thin bone (which could not be safely removed from the cloth) (Figure 4). The unidentified long bone was stuck to the shroud but not in any recognisable anatomical position. Based on its size and morphology, it could represent either one of the femurs or the left humerus. Judging from the shapes and position of the paper-thin bones, they most likely represent what survives of the left frontal bone (see Faro et al., 2005:Fig. 1; Macklin, 1914:Plate 4). A flat bone adhering to the posterior right-proper ribs, despite being damaged, could be identified as part of the primary ossification center of the right scapula.. Thus, all the recovered bones of the thorax were found in their anatomically correct positions. No other bones, cartilage or soft tissue were recovered.

Despite being extremely small and fragile, these skeletal parts were in surprisingly good condition. They exhibited an etched and fibrous surface morphology, but no pathological changes were identified. The mandible halves were well-preserved and complete; whereas, the other bones exhibited an abraded appearance to varying degrees. There was no evidence of direct contact with soil or sediment.

The preserved Gällared skeletal remains are consistent with those that are the first to form in normal first-trimester human development (Mall, 1906:Fig. 2; Noback & Robertson, 1951; O'Rahilly & Gardner, 1972). Osteological age assessment of young foetal and embryonic remains is greatly aided by the fact that almost all primary ossification centers appear in an ordered sequence during a short time span between foetal weeks 7 and 12 (Noback & Robertson, 1951). The mandible is the second bone to ossify after the clavicle (O'Rahilly & Gardner, 1972), starting when the foetus is about 6 foetal weeks (Table 1). All the other retrieved Gällared bones begin ossification in the 8^{th} to 9^{th} foetal weeks, which, taken together, gives an estimated age of at least 8 foetal weeks for the Gällared foetus. The frontal bone was compared with ultrasonographs of 7-32 week foetuses (Faro et al., 2005:Fig. 1) and was consistent with a 9-week foetus.

The dimensions of the right long bones, the first right rib (Table 2) and the mandible halves (Table 3) were measured. Minimal lengths are reported for the abraded bones. Ossification of the humerus begins as a bony collar around the shaft of the cartilage anlage (bone template). It starts when the foetal crown-rump length (CRL) is 19-30 mm, corresponding to the 8th foetal week (Gray & Gardner, 1969; Noback & Robertson, 1951; O'Rahilly & Gardner, 1972). The bone collar of the Gällared right humerus, although slightly abraded at one end, measured at least 4.6 mm. This falls in the range of a CRL of 37-57 mm (Gray & Gardner, 1969:Table 2), corresponding to mid-9th foetal week to the start of the 11th foetal week (Napolitano et al., 2014:Table 2).

The mandible halves were the only skeletal remains that appeared complete and un-abraded. Their dimensions (Table 3) were compared to the mandible dataset of Fazekas and Kósa (1978) (adapted by Schaefer et al., 2009:63) (Figure 5). The adapted dataset begins at 12 gestational (i.e. 10 foetal) weeks with a reported mandible body length range of 7.5-8.5 mm. The dataset of Fazekas and Kósa has been questioned because the authors used spontaneously aborted foetuses which were of uncertain gestational age and may have shown abnormal development. The applicability of their data can be judged in the context of more recent studies. Olsen et al. (2002) examined 495 modern foetuses from Bergen, Norway, 13% of which were procured abortions, while the rest were either perinatal or neonatal deaths. They found that the average bone lengths from their samples were shorter than those from equivalent studies concentrating on healthy foetuses. It should be noted that Olsen et al.'s data did not include any foetuses younger than a gestational age of 16 weeks, i.e. 14 foetal weeks. A comparison of estimated ages using Fazekas and Kósa's (1978) formula to spontaneously aborted foetal remains of known age (collected between 1902 and 1917) showed that the "Fazekas and Kósa model produced estimated ages similar to the known ages of the individuals in the historical data set" (Sanders, 2009:29).

In spite of questions arising from Fazekas and Kósa's data, in the context of the Gällared foetus, an extrapolation of their data for mandibular development is a useful adjunct to the measurements of the other bones. The body lengths of the Gällared foetus mandible halves are 6 mm (R) and 5.8 mm (L), respectively, indicating an age at death outside the Fazekas & Kósa (1978) range and, therefore, less than 10 foetal weeks. Regession analysis of the adapted Fazekas & Kósa's (1978) skeletal data set for the mandible extrapolated to encompass the Gällared mandible halves gives an age at death estimation in the 10th gestational week, i.e. 8th foetal week. Confidence in this estimated age is addressed further in the conclusions.

The Coffin and its Contents

The simple, crudely constructed, lidded wooden coffin is rectangular in shape (exterior dimensions:10.7 x 6.8 x 5.3 cm). It is complete and was intact when discovered. It is in good condition with no sign of past damp, soil staining or wood-boring insect activity. The off-white rectangular woven cotton shroud (14.7 x 8.5 cm) was fashioned from re-purposed clothing or household linen. It is intact, albeit with several weak areas, dry, flexible, and with staining on one half of its interior face. Both the coffin and shroud appear to have been tailor-made to house the foetal remains. If it is assumed that the Gällared foetal body was not stretched out but wrapped in its natural foetal position when laid in the coffin, the CRL of the foetus could not have exceed 6-7 cm to fit into the box (interior dimensions: 8.2 x 4.5 cm). This length corresponds to a 10-11 foetal week individual (Napolitano et al., 2014:Table 2), which is in agreement with the osteological evidence.

Fragmentary insect remains were found inside the coffin and scattered on the shroud. Microscopic examination determined these to be mostly parts of dermestid beetles at different life stages: a cast larval skin, a partial abdomen and a leg, plus the head of an ant

(Hovmöller, personal communication, 10 May 2016). The particular matter found in the shroud probably represents frass or fecal pellets from the beetle larvae. A more detailed discussion of the shroud can be found in Peacock et al. (2020).

DISCUSSION

Age Estimation

The state of ossification and morphological development of the Gällared skeletal remains give an estimated age of at least 8 foetal weeks; while, the dimensions of the right humerus indicate an age over just over 10 foetal weeks, which is consistent with the relatively well-developed rib cage. Mall (1906) reports that the 8 week-old foetus has 10 ribs and a well-proportioned thorax. The first rib ossifies slightly later than ribs 2-11, in week nine (Mall, 1906; Noback & Robertson, 1951).

Being the best-preserved of the Gällared elements, the mandible halves were used to narrow down the estimation of age at death. Mandible development and ossification in the human embryo are well known (e.g. Kvinnsland, 1969; Lee et al., 2001; Low, 1909; Wyganowska-Swiatkowska & Przystanska, 2011). The mandible's distinct shape arises from Meckel's cartilage from which the developing mandible derives (see Low, 1909:Fig. 4; Macklin, 1914:Plates 3 and 4). The primary ossification center of the mandible anlage develops lateral to Meckel's cartilage close to the mental nerve when the foetus is about 6 foetal weeks, and ossification spreads rapidly along the cartilage towards the condylar and coronoid processes (Kvinnsland, 1969; Mall,1906; Wyganowska-Swiatkowska & Przystanska, 2011:Table 1) (Figure 3B). Eventually, Meckel's cartilage is partially enveloped by bone (Wyganowska-Swiatkowska & Przystanska, 2011).

Different times for the onset of ossification of the condylar and coronoid processes of the mandible have been proposed (Furstman, 1963; Kvinnsland, 1969:Fig. 1; Mall, 1906; Müller & O'Rahilly, 1980; Radlanski et al., 1999; Wyganowska-Swiatkowska & Przystanska, 2011:Table 2); however, most of these fall into the range of foetal weeks 8 or 9. The Gällared mandible halves display neither condylar nor coronoid processes and the bones exhibit no evidence of postmortem damage; although, it is not entirely possible to rule out some removal of cartilaginous tissues by insect larvae. This indicates an age less than 9 foetal weeks. The condylar and coronoid processes are clearly visible in drawings by both Macklin (1914:Plate 4) and Low (1909:Fig. 4) of mandibles of foetuses about 9 weeks old (40 mm CRL and 43 mm CRL, respectively). These specimens are judged to be slightly older than the Gällared foetus. Comparison with more recent 3-dimensional reconstructions of the heads of early stage foetuses obtained from serial histological sections of prenatal mandibles (Radlanski & Rentz, (2010, and Supporting Information:Figs. S2.1-18, S3.1-35, and S4.1-15) provides additional insight. Compared to the scans of one 8-week foetus (Figs. S2.1-18), one 9-week foetus (Figs. S3.1-35) and one 11-week foetus (Figs. S4.1-15), the Gällared mandibles are judged to fall in the developmental range between the 8- and the 9-week foetuses. In the 11-week foetus, the condylar and coronoid processes are distinct and well ossified.

The data sets of Fazekas and Kósa (1978), which are widely used in age estimation studies of skeletal remains from archaeological contexts, have been questioned. One commonly raised problem with their data is that the foetuses were of forensic origin and largely of unknown age and that they were seriated according to crown-heel length and assigned an age (Cunningham et al., 2016:6, 9). However, if one plots their original data for mandible body length (a total of 138 individuals), the result is a straight line which can be fitted with a linear regression ($R^2 = 0.9947$) (see Figure 5). The youngest individuals in their data set (representing only five individuals) are slightly lower than the trend. Although the Gällared remains' age of less than three gestational months lies outside Fazekas and Kósa's

original sample range, a slight extrapolation of the data yields an age consistent with estimations from onset of ossification. This estimate is advanced only 3-4 days if the lengths are fitted to the offset from Fazekas and Kósa's regression line.

Taken together, it is estimated that the Gällared foetus died in week nine; thus, its age at death was between 8 and 9 foetal weeks. No pathological changes were identified in the bones, and there were no indications of why the foetus was miscarried.

Reconstructed taphonomy

The environmental conditions surrounding the concealed Gällared coffin would have consisted of low wintertime and cool summertime temperatures with generally low humidity, especially in winter. The church is situated on a small rise which would have contributed to good drainage and a dry, relatively stable space beneath the floor where the dry air probably caused mummification by rapid desiccation. The presence of minute fragments of dried tissue on the shroud and adhesion of bones to the cloth certainly suggest at least partial mummification. Mummification can be viewed as a competition between desiccation and decomposition (Micozzi, 1986). Deposition in a cool, dry and well-aerated space would be expected to accelerate water loss from the foetus by evaporation from the skin and the surrounding textile. The loosely wrapped shroud would quickly wick away any fluids leaking from the foetus (Aufderheide, 2003:303).

Experimental studies to investigate the effect of clothing on the rate of human postmortem tissue desiccation have shown that the most important factor influencing the rate of fluid loss is the environment at the skin surface, and that clothing accelerates this rate (Aturaliya & Lukasewycz,1999). Newly deceased mice were shaved and exposed in air or buried in sand for up to 69 days, either naked or wrapped in multiple layers of cotton strips. In air, the naked mouse lost 58.7% weight versus 71.3% for the cotton-wrapped mouse. The sand-buried naked mouse lost 60.7% weight versus 67.1% for the cotton-wrapped mouse (Aturaliya & Lukasewycz, 1999:Table 3). The Gällared foetus is estimated to have been 20-25 g (extrapolated from Fazekas & Kósa (1978) data set cited in Kósa, 1989:Table 2.1), similar to that of the specimen mice at 23-25 g. Aturaliya & Lukasewycz's studies suggest that the Gällared foetus may well have dried out within a short period. In similar studies of Nurminen et al. (2017), clothed piglets (stillborn and perinatal deaths) buried in coffins below church floors in Finland for a period of 109 days did not exhibit natural mummification, suggesting that body size is a critical factor.

The chemical composition of a foetus also differs from than that of an infant or adult, and in a foetus some of the normal stages of postmortem decomposition are curtailed or absent. An early term foetus is approximately 93.8% water (Moulton, 1923:Table 1), 3.7-4.5% protein (Brown et al., 2016; Toro-Ramos et al., 2015:Fig. 1) and less than 0.7% fat (Zeigler, 1977:Table 1). This compares to an adult human male (46 years) composition of 55.1% water, 18.6% protein and 19.4% fat (Forbes et al., 1953:Table 1). In legal medicine, a foetus issuing after 28 weeks of pregnancy, that at no point showed any signs of life after delivery is called a stillborn; whereas, a child that died in the uterus before the birth process begins, irrespective of the duration of the pregnancy, is regarded as a dead-born child (Bardale, 2011:354). This distinction has potential relevance for the fate of the Gällared foetus.

When an animal dies blood circulation ceases but cellular metabolism may continue for several minutes depending upon the type of tissue. Continuing aerobic respiration causes carbon dioxide to accumulate within cells, lowering the pH. The resulting acidification causes cellular membranes to rupture, releasing enzymes that begin to digest cells from the inside out – a process known as autolysis (Forbes & Dadour, 2010). The rate and extent of autolysis depends on the amount of water present and the temperature. There

will be a difference in the rate of autolytic decomposition of tissues depending upon whether it takes place while the foetus is still in the uterus, or after being expelled from the mother's body. A foetus which dies in utero is surrounded by amniotic fluid and remains at body temperature, conditions which will accelerate autolysis compared to one outside the mother's body (Lefebvre, 2015). Even so, there are reported cases of foetal mummification in utero in humans (Bardale, 2011:355) and domesticated animals (Lefebvre, 2015:Table 1). If expelled from the womb, then the large surface area of skin compared to the volume of water in the foetus means that desiccation may be quite rapid depending upon the ambient relative humidity and temperature.

Another thing that distinguishes stillbirths from babies that survive is the absence of intestinal flora. In normal postmortem decomposition there is rapid onset of putrefaction as endogenous bacteria spread from the gut to surrounding soft tissues (Burcham & Jordan, 2017) which they break down with the evolution of characteristic gasses and putrid odours. In recent years, the presence or absence of gut microbiota and its influence on bacterial degradation of skeletons has been invoked to identify previously mummified skeletal remains and to distinguish between the skeletons of stillborn and neonatal deaths (Parker Pearson et al., 2005, 2007; Booth, 2016; Booth et al., 2016). Although the Gällared bones were not examined for diagenetic alteration, one would not expect to see bacterial tunnelling in these bones since the foetal corpse would have no gut flora to initiate putrefaction upon death (Burcham & Jordan, 2017) and it had no direct contact with bacteria from the soil (Turner-Walker, 2019).

If the Gällared foetus was washed and dried after expulsion from the womb as seems likely, then bacterial and fungal degradation would effectively have been curtailed and mummification may very well have progressed before significant microbial decay. Creases in the shroud show that it was lightly folded, not tightly wound, around the foetus. The staining indicates that it was wrapped around something slightly damp, and that the foetal remains were not already dried when placed in the coffin. In a saturated state the foetus would have discoloured much of the fabric and caused biodegradation (which was not seen). The pattern of staining along one side points to the foetus being in intimate contact with the shroud, and that it was double-folded around the foetus with the short side parallel to the length of the body. The loose wrapping will have facilitated the drying out of the soft tissue and brought about relatively rapid desiccation (Bouquin et al., 2013:14). Furthermore, it would have restricted the scattering of the skeletal parts as the body decomposed, and thus led to those parts retaining the anatomically correct position of the foetal skeleton (Duday, 2009:45).

The evidence of beetles, but absence of flies, provides some clues about the environmental conditions in the small coffin. In a forensic context, blow flies (*Ophyra* sp.) are among the first insects to visit a corpse and they prefer to feed on bodies before they become dried out. That there was no evidence of Ophyra in the coffin may indicate that these larger flies could not find their way into the coffin or shroud, or that it was interred during cold months (Turner-Walker & Scull, 1997). The coffin did hold at least one cast skin of a dermestid larva. These are typically small (adult carpet beetles, *Anthrenus verbasci* are 2-3 mm long) and would be able to infiltrate small cracks and crevices to gain access to the interior of the coffin. The larvae feed on dead animal remains and are relatively late arrivals, feeding on dried skin and tendons, fur and feathers. Their presence indicates dried tissues were an available foodsource. They would have consumed any dried tissue, un-mineralised cartilage, and presumably the periosteum, leaving the denser ossified skeletal parts. Electron microscope studies have demonstrated that the mouthparts of dermestids can modify the surfaces of bones a fibrous appearance (Fernández-Jalvo & Marín Monford, 2008:Fig. 3) which is consistent with the texture of the Gällared remains.

Cultural Beliefs and Practices

The circumstances of the Gällared foetus highlight an aspect of the experience of being a woman during the 19th century. Spontaneous abortion is common, occurring in 25-30% of all pregnancies, and approximately 80% of these occur during the first 12 weeks of pregnancy, the risk increasing with the age of the mother (Moore et al., 2020; Avalos et al., 2012). At this time, miscarriage, stillbirth and infant death were far greater health issues than they are today. This is reflected in data from Swedish parish records (Figure 6) and had a bearing on society's attitudes and beliefs towards lost pregnancies and the burial and mourning practices afforded miscarried foetuses (Tarlow, 2013). Gällared was a poor rural community. It is assumed that the mother of the Gällared foetus miscarried in late summer of 1831, a year in which heavy rains delayed sowing, damaged crops and caused a poor harvest, as well as one in which the community suffered a typhoid epidemic (Karlsson 1982). Beliefs and actions regarding miscarriage are described extensively in folklore and ethnological accounts (Hagberg, 2015; Bø, 1960). These included that miscarriage was a punishment of would-be parents who had behaved inappropriately or was a result of violating the rules of conduct for a pregnant woman. Folk tales held that if not buried in the cemetery, the foetus could potentially become a restless spirit, a so-called "*myling*", the soul of an unburied child who roamed the forest (Hagberg, 2015; Kättström-Höök, 2015; Lindquist, 1981; Bø, 1960). The Gällared burial ritual witnesses a defiance of the norms and rules imposed by the Swedish church. The experience of bereavement and associated physiological and emotional grief of losing a child (Gowland 2020) were strong motivators to break the rules to secure burial in sacred ground and to give the child a chance of salvation. The risk of being caught and legally punished was not a strong enough deterrent.

Under late 18th-early 19th-century Swedish law, a foetus was not recognised as an individual, i.e. person in its own right (Edgren, 2010; Sandin, 2009, 2013). Despite its young age, the Gällared foetus was considered a person with a hoped-for future; upon death, a person with a potential role in the afterlife and entitled to funerary treatment and burial in sacred ground. It was handled with care and dignity after its death and buried with attention to details. Coffin and shroud were fashioned with care and witness an adherence to providing as decent and appropriate a burial as possible (Davidson, 2016; Douny & Harris, 2014). The parents made conscious decisions about the manner in which the deceased foetus was treated and arrangements for its emotionally motivated internment in sacred ground (Cannon & Cook 2015). The care afforded the Gällared foetus contrasts starkly with descriptions of the disposal of aborted pregnancies in contemporary 19th-century urban America (e.g. Crist 2005). The shame associated with being an unwed mother or to experience a miscarriage, which in the eyes of society could result from unacceptable conduct of the mother, led women to give birth in secret and dispose of the baby in a privy – a place that guaranteed privacy.

CONCLUSION

The occasion of the providentially found concealed interment in Gällared Parish Church (1831) of a foetus miscarried in week nine provided the rare opportunity to undertake a systematic study of an early-stage foetus recovered from an archaeological context and its associated postmortem care. The applicability of juvenile human osteological texts to first-trimester archaeological skeletal remains is limited; whereas, the embryological literature is better suited. The fact that almost all primary ossification centers appear in an ordered sequence during the time interval between 7-12 foetal weeks (Noback & Robertson, 1951), facilitates a more targeted age estimation because the skeleton undergoes extensive development in these weeks. Being one of the first bones to ossify and easily identifiable due to its distinct shape, as well as its potential for recovery in burials of early-stage foetuses,

singles out the foetal mandible for future research. The measurement series of foetuses this small is limited and additional comparative data are needed for more reliable age assessments.

Detailed examination of the coffin and its contents provides broader insight into both the postmortem and depositional history of the foetus and, ultimately, its preservation by partial natural mummification. With knowledge of human behavior, it is easy to imagine that the miscarried Gällared foetus was afforded the same compassionate care as a newborn. As soon as the opportunity arose, it would have been washed, patted dry, wrapped in a cloth and kept safe until carefully placed in the tailor-made shroud and coffin and interred. With no gut flora to putrefy upon death, postmortem decomposition of the wrapped foetus would have been delayed, or curtailed, allowing it to dehydrate leading to desiccation prior to becoming fully skeletonized by insects.

The concealed interment of miscarriages in small coffins in and around churches is no longer in living memory. Had the workers been aware of this tradition, the small box would not have been opened nor its contents made available for study for ethical reasons. The Gällared foetus remains will be returned to their shroud and coffin and reinterred beneath the floorboards in Gällared Parish Church where they were discovered (U. Andersson, personal communication, 1 February 2019).

DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of the study reported herein are available within the article [and/or] its supplementary materials.

ACKNOWLEDGEMENTS

The authors are grateful to C. Owen Lovejoy, Leif Jonsson, Rasmus Hovmöller, Uno Andersson and Anna Kjellström for their generous advice, to Markus Andersson for photography and to Gällared Parish Council for permission to carry out and publish this study. Additionally, the authors would like to thank two anonymous reviewers for their constructive comments.

SUPPORTING INFORMATION

Table S1 provides the Fazekas and Kósa (1978) data set that is plotted in Figure 5.

REFERENCES

Aturaliya S, and Lukasewycz A. 1999. Experimental forensic and bioanthropological aspects of soft tissue taphonomy: 1. Factors influencing postmortem tissue desiccation rate. *Journal of Forensic Science* **44**: 893-896.

Aufderheide AC. 2003. *The Scientific Study of Mummies*, Cambridge University Press: Cambridge.

Avalos LA, Galindo C, Li, D-K. 2012. A systematic review to calculate background miscarriage rates using life table analysis. *Birth Defects Research (Part A),* **94**: 417-423. DOI: 10.1002/bdra.23014

Bardale R. 2011. *Principle of Forensic Medicine and Toxicology*. JayPee Brothers Medical Publishers: New Delhi.

Bouquin B, Beauthier J-P, Depierre G. 2013. The dead do not dress: contribution of forensic anthropology experiments to burial practices analysis. In *Proceedings of the 17th International Conference on Cultural Heritage and New Technologies 2012*, Börner W, Uhlirz S (eds). Museen der Stadt Wien: Vienna; 1-16.

Booth TJ. 2016. An investigation into the relationship between bacterial bioerosion and

funerary treatment in European archaeological bone. *Archaeometry* **58**(3): 484-499. DOI: 10.1111/arcm.12190
Booth TJ, Madgwick R. 2016. New evidence for diverse secondary burial practices in iron age Britain: a histological case study. *Journal of Archaeological Science* **67**: 14-24. DOI: 10.1016/j.jas.2016.01.010
Brown LD, Regnault TRH, Hey WW Jr. 2016. Fetal requirements and placental transfer of nitrogenous compounds. SECTION VIII — Protein metabolism. In *Fetal and Neonatal Physiology*, Polin RA, Abman SH, Rowitch DH, Benitz WE, Fox WW (eds). Elsevier: Philadelphia, PA; 444-458.
Burcham ZM, Jordan HR 2017. History, current, and future use of microorganisms and physical evidence. In *Forensic Microbiology*, Carter DO, Tomberlin JK, Benbow ME, Metcalf JL (eds). Wiley; 25-55.
Bø O. 1960. Øskjer i kyrkjemuren. *Norveg: Journal of Norweigan Ethnology and Folklore Studies* **7**: 99-152.
Cannon A, Cook K. 2015. Infant death and the archaeology of grief. *Cambridge Archaeological Journal* **25**(2): 399-416. DOI: 10.1017/S0959774315000049
Crist A. 2005. Babies in the privy: prostituionm infanticide and abortion in New York City's Five Points District. *Historical Archaeology* **3**: 19-46. DOI: 10.1007/BF03376675
Cunningham C, Scheuer L, Black S. 2016. *Developmental Juvenile Osteology*. Elsevier Science: St. Louis.
Davidson H. 2016. Grave emotions: textiles and clothing from nineteenth-century London cemeteries. *Textile* **14**(2): 226-243. DOI: 10.1080/14759756.2016.1139383
Duday H. 2009. *The Archeology of the Dead: Lectures in Archaeothanatology*. Translated by Cipriani AM, Pearce J. Oxbow Books: Oxford.
Douny L, Harris S. 2014. Wrapping and unwrapping, concepts and approaches. In *Wrapping and Unwrapping Material: Archaeological and Anthropological Perspectives*, S. Harris and L. Douny (eds). Left Coast Press: Walnut Creek, CA; 15-40.
Edgren M. 2010. Colonizing women's bodies: population policies and nationhood in eighteenth-century Sweden. *Journal of Women's History* **22**: 108-132. DOI: 10.1353/jowh.0.0146
Faro C, Benoit B, Wegrzyn P, Chaoui R, Nicolaides K. 2005. Three-dimensional sonographic description of the fetal frontal bones and metopic suture. *Ultrasound in Obstetrics and Gynecology* **26**: 618–621. DOI: 10.1002/uog.1997
Fazekas IG, Kósa F. 1978. *Forensic Fetal Osteology*. Akcdémiai Kiadó: Budapest.
Fernández-Jalvoa Y, Marín Monfort MD. 2008. Experimental taphonomy in museums: Preparation protocols for skeletons and fossil vertebrates under the scanning electron microscopy. *Geobios* **41**: 157-181. DOI: 10.1016/j.geobios.2006.06.006
Forbes RM, Cooper AR, Mitchell HH. 1953. The composition of the adult human body as determined by chemical analysis. *Journal of Biological Chemistry* **203**: 359-366.
Forbes SL, Dadour I. 2010. The soil environment and forensic entomology. In *Forensic Entomology: The Utility of Arthropods in Legal Investigations*, Byrd JH, Castner JL (eds). CRC Press: Boca Raton, FL; 407-426.
Furstman L. 1963. The early development of the human temporomandibular joint. *American Journal of Orthodontics* **49**: 672-682. DOI: 10.1016/0002-9416(63)90038-1
Gardner E, Gray DJ. 1970. The prenatal development of the human femur. *American Journal of Anatomy* **129**: 121–140. DOI: 10.1002/aja.1001290202
Gowland R. 2020. Ruptured: reporductive loss,bodily boundaries,time andlife course in

archaeology. *In The Mother-Infant Nexus in Anthropology, Bioarchaeology and Social Theory*, Gowland R, Harlow. S (eds.). Springer Nature Switzerland; 257 274. DOI: 10.1007/978-3-030-27393_14

Gray DJ, Gardner E. 1969. The prenatal development of the human humerus. *American Journal of Anatomy* **124**: 431–445. DOI: 10.1002/aja.1001240403

Hagberg L. 2015. *När döden gästar. Svenska folkseder och svensk folktro i samband med död och begravning*. New edition. Ersatz: Stcokholm.

Halcrow S, Tayles N, Elliott GE. 2018. The bioarchaeology of fetuses. In *The anthropology of the Fetus: Biology, Culture and Society*, Han S, Betsinger T, Scott AB (eds). Berghahn Books: New York, NY; 83-111.

Jonsson K. 2006. Från Karon till Sankte Per - gravskick i Skandinavien under efterreformatorisk tid. In *Lik og ulik: Tilnærminger til variasjon i gravskikk*, Østigård T (ed). UBAS Nordisk **2:** 69-93.

Jonsson K. 1999. Bland barnaföderskor, spädbarn och ”vuxna barn” – social och religiös kontroll speglad i gravmaterialet från Västerhus. *META medeltidsarkeologisk tidskrift* **1999**: 12-35.

Karlsson G. 1982. Gällareds kyrka. In *Gällared en bok om kamp för överlevnad*, Andersson C, Johansson M, Karlsson G, Larsson O, Larsson S, Nilsson J, Skantze A (eds). Gällareds Hembygdsförening: Laholm; 47-65.

Kättström-Höök L. 2015. Från foster til dop. Hur man skyddar en hedning. In *Se åldern. Fataburen* **2015**, *Carlsson A. (ed). Nordiska museets och Skansens årsbok* 13-37.

Kósa F. 1989. Age estimation from the fetal skeleton. In *Age Markers in the Human Skeleton*, Iscan IM (ed). Charles C Thomas: Springfield, IL; 21-54.

Kvinnsland S. 1969. Observations on the early ossification process of the mandible as seen in plastic embedded human embryos. *Acta Odontologica Scandinavica* **27**: 643-648. DOI: 10.3109/00016356909026314

Lee SK, Kim YS, Oh HS, Yang KH, Kim EC, Chi JG. 2001. Prenatal development of the human mandible. *Anatomical Record* **263**: 314–32. DOI: 10.1002/ar.1110

Lefebvre RC. 2015. Fetal mummification in the major domestic species: current perspectives on causes and management. *Veterinary Medicine : Research and Reports* **6:** 233-244. DOI: 10.2147/VMRR.S59520

Lindquist M. 1981. Mylingar – offer, utsatta barn eller förhistoriska barnbegravningar? *Gotländskt Arkiv* **1981**: 7-12

Lipkin S, Väre T, Kallio-Seppä T. 2018. Pappissäädyn haudat Pohjois-Pohjanmaan kirkkojen lattioiden alla – Tapaustutkimuksia 1300-1700-luvuilta. *Thanatos* **7**(2): 60-89.

Londos E. 1995. Om askegossen från Bringetofta och döda barns begravning. In *Småländska kulturbilder. Från Kyrkans värld,* Börjesson, K (ed). *Meddelanden från Jönköpings Läns Hembygdsförbund och Stiftelsen Jönköpings Läns Museum* **65**. Jönköpings läns museum: Jönköping; 49-54.

Low A. 1909. Further observations on the ossification of the human lower jaw**.** *Journal of Anatomy and Physiology* **44**: 83-95.

Macklin CC. 1914. The skull of a human fetus of 40mm I. *American Journal of Anatomy* **16**: 317-386. DOI: 10.1002/aja.1000160303

Mall FP. 1906. On ossification centers in human embryos less than one hundred days old. *American Journal of Anatomy* **5**: 433-458. DOI: 10.1002/aja.1000050403

Magnussen ARS. 2006. Fosterbegravelser – en skikk utenom alle skikker. In *Lik og ulik: tilnærminger til variasjon i gravskikk,* T. Østigård (ed). *UBAS Nordisk* 2: 53-67.

Mays S, Gowland R, Halcrow S, Murphy E. 2017. Child bioarchaeology: Perspectives on the

past 10 years. *Childhood in the Past* **10**(1): 38-56. DOI: 10.1080/17585716.2017.1301066

McCabe Allen ME. 2016. *The Difference of Being in the Early Modern World: A Relational material Approach to Life in Scotland in the Period of the Witch Trials*. PhD thesis. University of Glasgow: Glasgow.

Micozzi MS.1986. Experimental study of postmortem change under field conditions: effects of freezing, thawing, and mechanical injury. *Journal of Forensic Sciences* **31**: 953-961.

Moore KL, Persuad TVN, Torchia MG. 2020. *The Developing Human. Clinicaly Oriented Embryology*. Elsevier: Edinbugh.

Moulton CIR. 1923. Age and chemical development in mammals. *Journal of Biological Chemistry* **57**: 79-97.

Murphy E. 2011. Children's burial grounds in Ireland (cilliní) and parental emotions towards infant death. *International Journal of Historical Archaeology* **15**: 409-428. DOI: 10.1007/s10761-011-0148-8

Murphy E, McCarthy R. 2009. *Skeletal Inventory of the Juvenile Human Remains from the Ballyhanna Skeletal Assemblage, Co. Donegal (Site No: 03E1384)*. The Ballyhanna Research Project.

Müller F, O'Rahilly R. 1980. The human chondro-cranium at the end of the embryonic period, proper, with particular reference to the nervous system. *American Journal of Anatomy* **159**(1): 33-58. DOI: 10.1002/aja.1001590105

Napolitano R, Dhami J, Ohuma EO, Ioannou C, Conde-Agudelo A, Kennedy SH, Villar J, Papageorghiou AT. 2014. Pregnancy dating by fetal crown-rump length: a systematic review of charts. *BJOG: An International Journal of Obstetrics and Gynaecolgy* **121**(15): 556-565. DOI: 10.1111/1471-0528.12478

Noback CR, Robertson GG. 1951. Sequences of appearance of ossification centres in the human skeleton during the first five prenatal months. *American Journal of Anatomy* **89**: 1-28. DOI: 10.1002/aja.1000890102

Nurminen N, Lipkin S, Kuha A, Väre T, Marjakangas S, Niskanen M, Junno J-A. 2017. Experimental mummification in northern Finland. *Fennoscandia Archaeologica* **XXXIV**: 146-151.

Olsen OE, Lie RT, Maartmann-Moe H, Pirhonen J, Lachman RS, Rosendahl K. 2002. Skeletal measurements among infants who die during the perinatal period: new population-based reference. *Pediatric Radiology* **32**: 667-673. DOI: 10.1007/s00247-001-0627-x

O'Rahilly R, Gardner E. 1972. The innitial appearance of ossification in staged human embryos. *American Journal of Anatomy* **134**: 291-307. DOI: 10.1002/aja.1001340303

Parker Pearson M, Chamberlain A, Craig O, Marshall P, Mulville J, Smith C, Chenery C, Collins M, Cook G, Evans J, Hiller J, Montgomery J, Schwenninger J-L, Taylor G, Wess T. 2005. Evidence for mummification in Bronze Age Britain. *Antiquity* **79**(305): 529-546.

Parker Pearson M, Chamberlain A, Collins M, Cox C, Craig O, Hiller J, Marshall P, Mulville J, Smith C. 2007. Further evidence for mummification in Bronze Age Britain. *Antiquity* **81**: 312-322.

Peacock EE, Tegnhed S, Maltin E, Turner-Walker G. 2020. The Gällared shroud and the preservation of a clandestine early 19th cenutry foetal burial. *Archaeological Textiles Review* **62**.

Radlanski RJ, Lieck S, Bontschev NE. 1999. Development of the human temporomandibular

joint. Computer-aided 3D-reconstructions. *European Journal of Oral Sciences* **107**: 25-34. DOI: 10.1046/j.0909-8836.1999.eos107106.x

Radlanski RJ, Renz H. 2010. An atlas of prenatal development of the human orofacial region. *European Journal of Oral Sciences* **118**: 321-324. DOI: 10.1111/j.1600-0722.2010.00756.x

Sanders JE. 2009. *Age Estimation of Fetal Skeletal Remains from the Forensic Context*. Theses, Dissertations, & Professional Papers. Paper 107. University of Montana.

Sandin B. 2013. Infanticide, abortion, children, and childhood in Sweden, 1000-1980. In *The Routledge History of Childhood in the Western World*, Fass PS (ed). Routledge: London; 360-379

Sandin B. 2009. Foetal identity redefined – notes on the changing identity of the foetus in the nineteenth and early twentieth centuries. In *Barn, barndom och föräldraskap*, Markström A-M, Simonsson M, Söderlind I, Änggård AE. (eds.). Carlsons Förlag: Stockholm; 32-53

Schaefer M, Black S, Scheuer L. 2009. *Juvenile Osteology. A Laboratory and Field Manual.* Academic: London.

Sellevold BJ. 2008. Kistebegravelser i Urnes stavkirke. *Rapport Antropologiske undersøkelser* **01/2008**. NIKU: Oslo.

Tarlow S: 2013. Belief and the archaeology of death. In *The Oxford Handbook of the Archaeology of Death and Burial*, Tarlow S, Nilsson Stutz L (eds). Oxford University Press: Oxford; 617-630

Tegnhed S. 2016. Förundersökning inom västra delen av Gällareds kyrka i samband med sänkning av marknivå under bjälklaget. *Arkivrapport Kulturmiljö Halland*. Kulturmiljö Halland: Hamstad.

Toro-Ramos T, Paley C, Pi-Sunyer FX, Gallagher D. 2015. Body composition during fetal development and infancy through the age of 5 years. *European Journal of Clinical Nutrition* **69**: 1279–1289.

Turner-Walker G. 2019. Light at the end of the tunnels? The origins of microbial bioerosion in mineralised collagen. *Palaeogeography, Paleoclimatology, Palaeoecology* **529**: 24-38. DOI: 10.1016/j.palaeo.2019.05.020

Turner-Walker G, Scull CJ. 1997. Microfauna in Anglo-Saxon graves; entomological evidence from burials at Boss Hall and the Butter Market, Ipswich. In *Archaeological Sciences 1995*, Sinclair A, Slater EA, Gowlett J (eds). Oxbow Monograph **64**. Oxbow Books: Oxford; 320-327. DOI: 10.2307/j.ctvh1dtz1.54

Woods R. 2008. Long-term trends in fetal mortality: implications for developing countries. *Bulletin of the World Health Organization* **86**(6): 460–466. DOI: 10.2471/BLT.07.043471

Wyganowska-Świątkowska M, Przystańska A. 2011. The Meckel's cartilage in human embryonic and early fetal periods. *Anatomical Science International* **86**: 98-107. DOI: 10.1007/s12565-010-0093-3

Zeigler EE, O'Donnell AM, Nelson SE, Fomon SJ. 1976. Body composition of the reference fetus. *Growth* **40**: 329-341.

Zircle D, Lovejoy CO. 2019. The hominid ilium is shaped by a synapomorphic growth mechanism. *Proceedings of the National Academy of Sciences of the United States of America*, **116**: 13915-13920. DOI: 10.1073/pnas.1905242116

TABLE 1 Times of initial onset of ossification in the human foetus

Skeletal element	Onset (fetal weeks)
Frontale [a]	8
Mandible [b]	6
Ribs [c]	8-9
Scapula [d]	8-9
Humerus [e]	8
Femur [f]	8-9

[a] Faro et al., 2005. [b] Mall, 1906:Table 1; Wyganowska-Świątkowska & Przystańska, 2011, Table 1. [c] Mall, 1906; Noback & Robertson, 1951.[d] O'Rahilly & Gardner, 1972; Noback & Robertson, 1951; Mall 1906. [e] Gray & Gardner, 1969. [f] Gardner & Gray, 1970.

TABLE 2 Dimensions of post-cranial skeletal elements of the Gällared foetus.

Skeletal element	Length (mm)
Minimum length of unidentified long bone (femur or left humerus)	3.9
Minimum length of right humerus	4.6
First right rib	2.1

TABLE 3 Dimensions (after Schaefer et al., 2009:93) of the Gällared foetus mandible halves

Measurement	Left (mm)	Right (mm)
Body length [a]	6.0	5.8
Body width [b]	1.9	1.9
Body oblique length [c]	7.3	7.2

[a] Body length: from tuberculum mentale to mandibular angle.
[b] Body width: posterior border of condyle to tip of coronoid process.
[c] Body oblique length: from tuberculum mentale to posterior border of condyle.

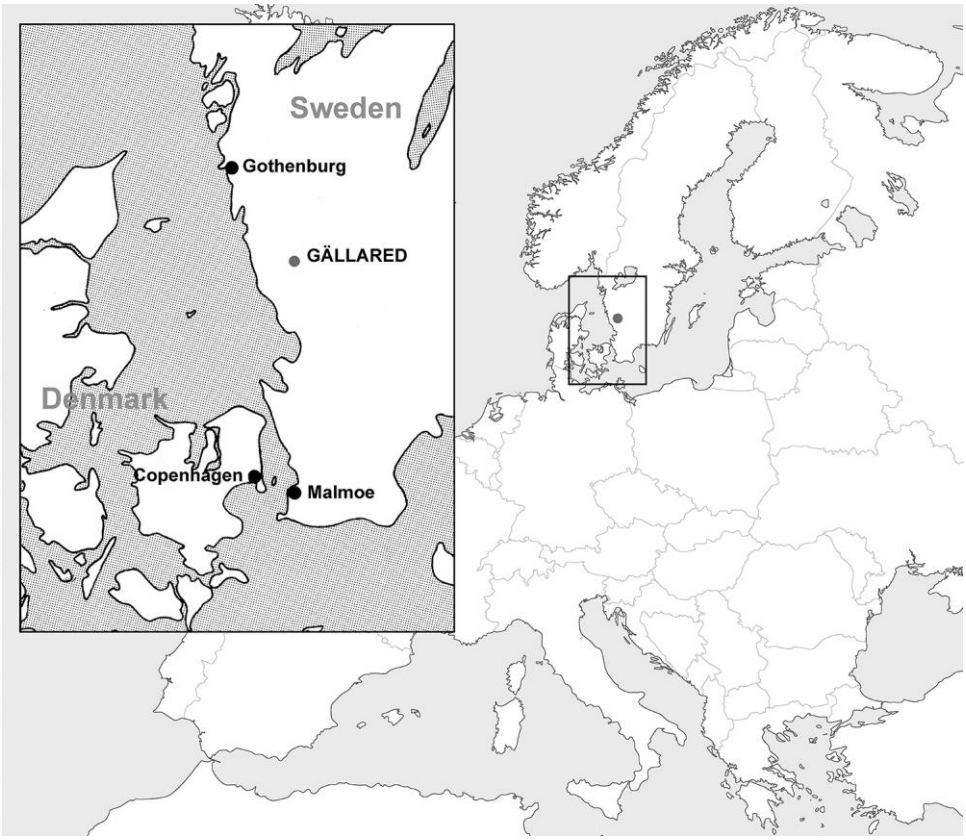

FIGURE 1 Location of the village of Gällared in southwest Sweden (Drawing: A. Andersson, Kulturmiljö Halland).

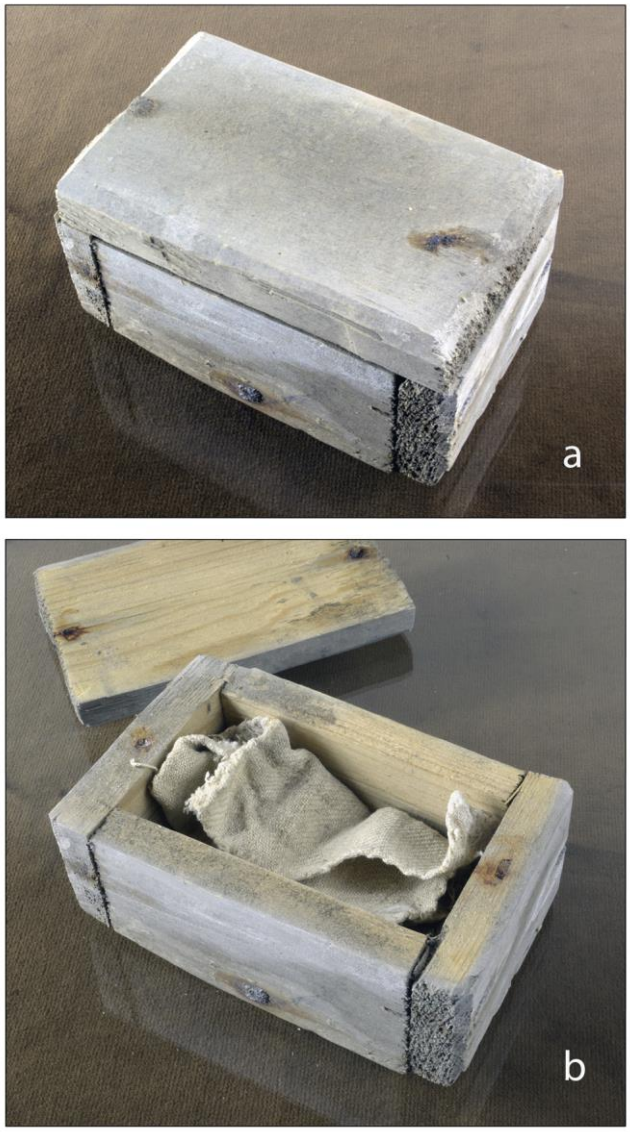

FIGURE 2 The Gällared wooden coffin (10.7 x 6.8 x 5.3 cm) containing the wrapped foetal remains. (a) the closed coffin. (b) the open coffin with textile burial shroud (Images: A. Andersson, Kulturmiljö Halland).

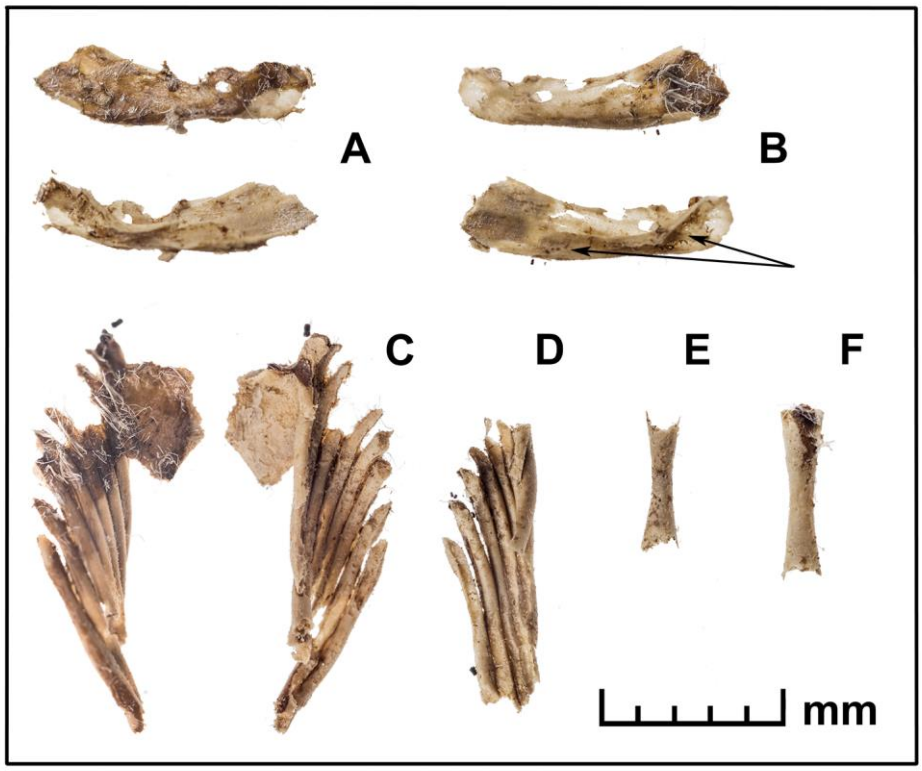

FIGURE 3 The Gällared foetus skeletal remains. A and B: Right and left mandible halves, respectively. Upper A and B: The two mandible halves from a lateral view. Lower A and B: The two mandible halves from a medial view. C: Right ribcage and scapula from a dorsal (posterior) view (left) and a ventral (anterior) view (right). D: Left ribcage from a ventral (anterior) view. E: Unidentified long bone. Panel F: Right humerus. (←) indicates the cavity for Meckel's cartilage on the medial side and foramen mentale (compare Low, 1909:Fig. 4; Macklin 1914:Plate 3 and Plate 4). (Images: M. Andersson, Kulturmiljö Halland). Note: The scale is for comparison only and should not be used for measurements.

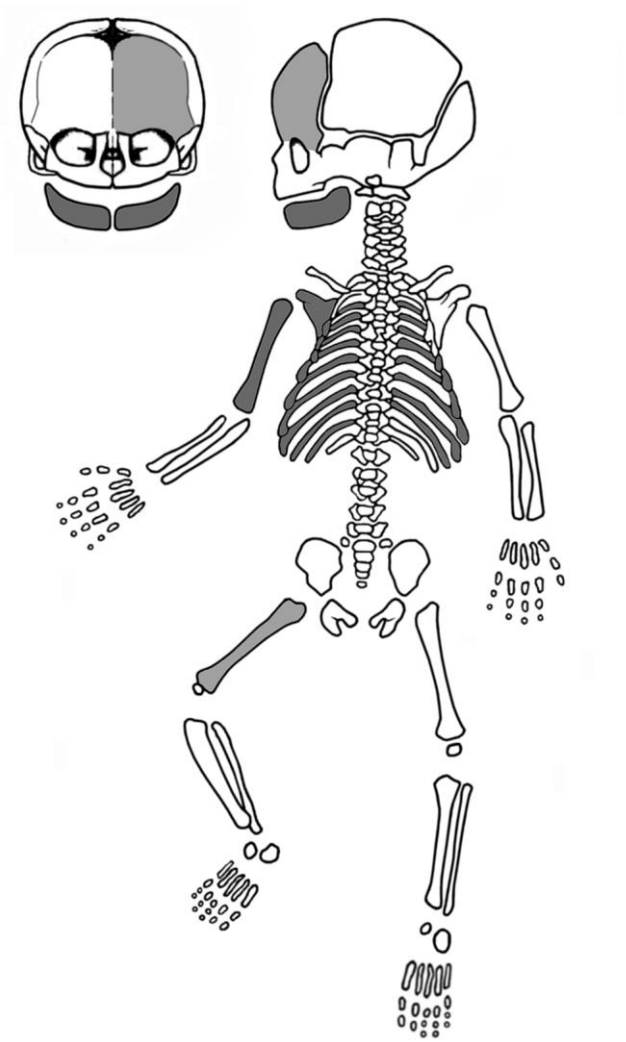

FIGURE 4 Recovered skeletal elements of the Gällared foetus. Bones in dark grey were identified based on morphology. Those in light grey were identifications based on their relative positions. (After Murphy & McCarthy, 2009).

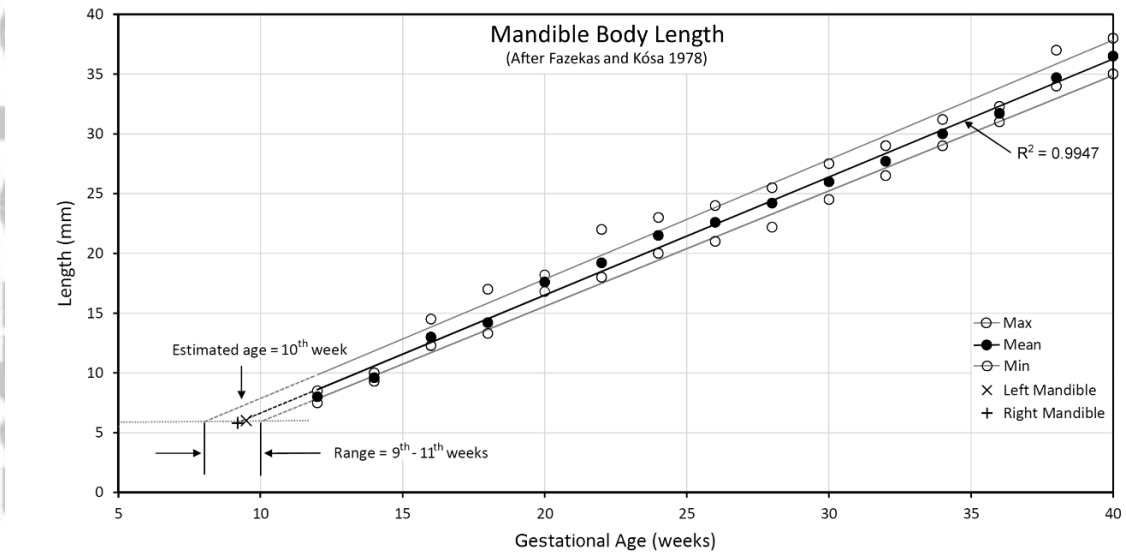

FIGURE 5 Estimated age at death in gestational weeks of the Gällared foetus from bone measurements of the complete mandible halves. The mandible body length data set of Fazekas and Kósa (1978) adapted by Schaefer et al. (2009:63) is plotted. Regression analysis of minimum, maximum and mean dimensions are extrapolated to include the bone measurements of the Gällared mandible halves. Using Fazekas and Kósa's data set, the age at death is in the 10^{th} gestational week – the 8^{th} foetal week - ± 1 week.

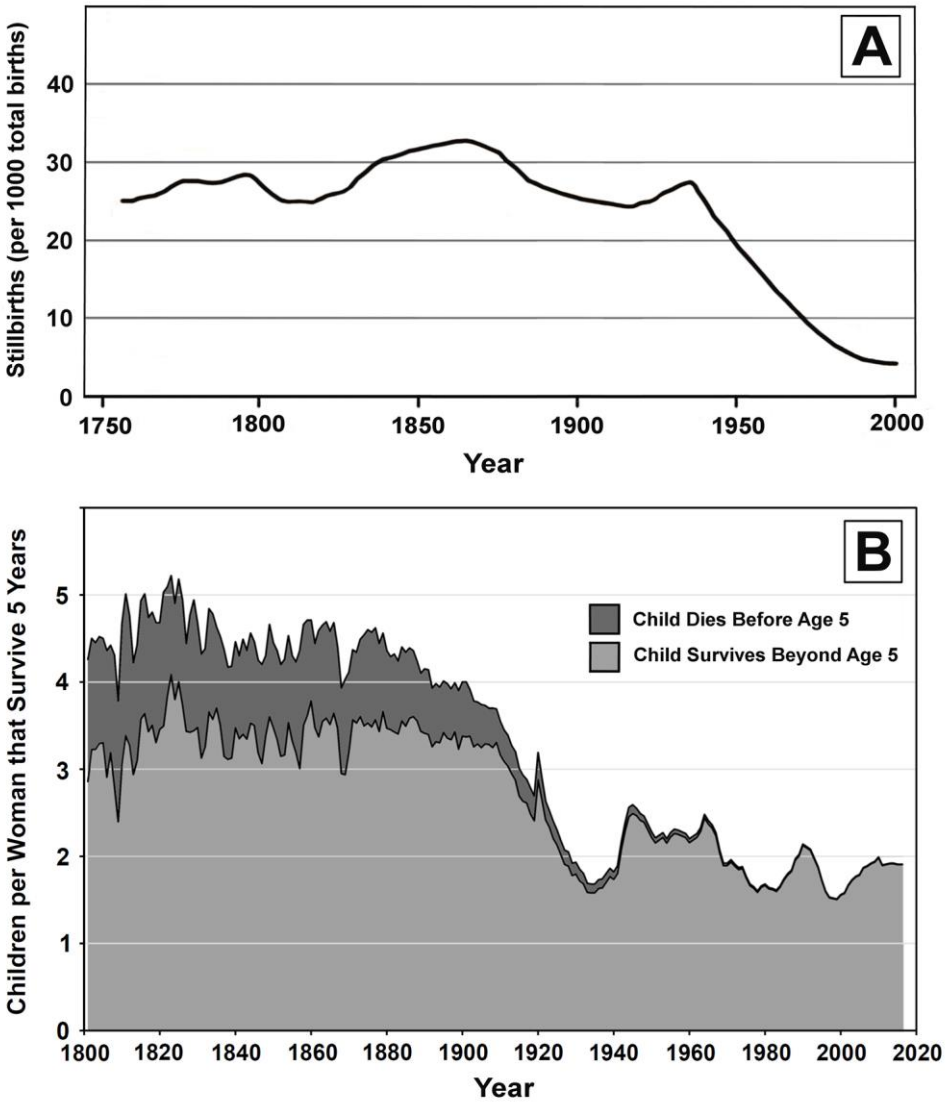

FIGURE 6…(A) Long-term trends in late-foetal mortality for Sweden (data taken from Woods, 2008). (B) Children per woman that survived childhood vs those that died in childhood, Sweden, 1800-2016 (redrawn from https://ourworldindata.org/child-mortality#estimates-for-child-mortality-over-the-last-two-centuries, and https://ourworldindata.org/fertility-rate#total-fertility-rate-around-the-world-over-recent-centuries).