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Research Articles

Missing, Presumed Buried? Bone Diagenesis and the Under-Representation of Anglo-Saxon Children.

[Jo Buckberry](#)

Sam Lucy ([1994](#): 26) has stated that a 'recognised feature of pre-Christian early medieval cemeteries in eastern England is the smaller number of younger burials recovered'. Although taphonomic factors such as the increased rate of decay of the remains of children and shallow depth of burial have been suggested as possible explanations for this phenomenon, these have been disregarded in favour of cultural influences, with younger children thought to have been disposed of in a different way from adult remains ([Lucy, 1994](#); [Härke, 1997](#); [Crawford, 1999](#)). This paper will review the evidence concerning the treatment of the remains of children during the Anglo-Saxon period. It will then review the factors affecting bone preservation, with special reference to the bones of children, and attempt to assess to what extent the under-representation of children in Anglo-Saxon cemeteries can be attributed to bone preservation and soil type. It will show that hypotheses should not be formulated without full consideration of the taphonomy that may affect the completeness of the archaeological record.

The Problem to be Addressed.

Populations represented in the pre-modern archaeological record are believed to have had a similar demography to modern pre-industrial societies. The pattern of mortality of such populations is characterised by high infant (less than one year old) mortality. This remains high between 1 and 5 years of age, and then decreases steadily, with those between 10 and 15 years having the lowest mortality rates of all age classes ([Weiss, 1973](#)). Estimates of infant mortality range between 40 and 50 percent ([Coale & Demeny, 1983](#)). The applicability of modern pre-industrial and third world life tables has been questioned more recently ([Härke, 1997](#)), however, archaeological populations for other time periods do show much higher levels of infant mortality (see below), indicating that these life tables are likely to give a reasonable representation of past demography. An archaeological sample of deaths consisting of less than 30% sub-adults is generally regarded to have been affected by a preservational or recovery bias ([Grauer, 1991](#)).

Crawford's ([1993](#)) study of the frequency of the remains of children revealed that in a sample of 1271 skeletons from early Anglo-Saxon cemeteries, less than 6% were under three years of age and only 11% were under five years of age. Molleson's ([1991](#)) study also revealed a deficiency of juvenile burials in Anglo-Saxon cemeteries, when compared with Romano-British sites. These figures are much lower than those expected for the distribution of deaths in a pre-industrial society. The possible reasons offered for this were that the bones of children decompose more easily, that children were buried in shallower graves and were consequently ploughed away or dug up by scavengers, or that they were disposed of in a different way, perhaps buried in separate

cemeteries for children ([Molleson, 1991](#); [Crawford, 1993](#); [Mays, 1998](#); [Crawford, 1999](#)).

Site	Period	% Children Recovered
Owlesbury, Hants.	Roman	34.8% under 5 years
St. Andrews, York	Medieval	36.6% under 20 years
St. Helens-in-the-Walls, York	Medieval	27.3% 'children'

Table 1: Percentage of Children Recovered for Different Archaeological Time Periods (Data from [Lucy, 1994](#)).

[Lucy \(1994\)](#) suggests that since the remains of children survive from other periods (see [Table 1](#), above) in much greater quantities, preservation rates cannot entirely resolve the problem. She hypothesised that if the children were buried in shallower graves this would indicate that they were not held in such high regard as adults buried in deeper graves. Alternatively, children may have been disposed of in a different way from adult remains, or buried in a different location ([Lucy, 1994](#); [Crawford, 1999](#)). If children were accorded different burial rites than adults, it would imply that they might have been seen as different from the adults in the society in which they lived ([Crawford, 1991, 1999](#); [Lucy, 1994](#)). It has been suggested that the increase in the numbers of children recovered from later Anglo-Saxon cemeteries may reflect a change in ideology, and that the new Christian church placed a higher emphasis on the burial of the remains of children with the remainder of the community, or in deeper graves ([Lucy, 1994](#)).

Other studies, both ethnographic and archaeological, have revealed that some societies may not regard children as fully human until they have passed a particular developmental stage, and thus are treated differently in the mortuary record ([Ucko, 1969](#); [Woodburn, 1982](#); [Tooley, 1983](#); [Smith & Kahila, 1992](#)). If the difference in burial rite accorded is indeed a reflection of social attitudes towards children, then we need to establish at what age children were considered adults in the Anglo-Saxon period. On the basis of the types of grave goods included in pre-Christian graves and documentary evidence from the Christian period, it appears that this distinction was usually made between 10 and 12 years of age ([Crawford, 1991, 1999](#); [Keufler, 1991](#)), although there are exceptions to this general trend.

The Preservation of Bone.

Bone consists mostly of protein (20-25% of fresh adult bone) and mineral (most of which is hydroxyapatite). Its strength as a material derives from the relationship between these two components, known as the protein-mineral bond ([Garland & Janaway, 1989](#); [Nielsen-Marsh et al, in press](#)). Once this bond is altered both the protein and mineral components become more susceptible to degradation, affecting both the chemical and morphological integrity of bone ([Garland & Janaway, 1989](#); [Nielsen-Marsh et al, in press](#)). Current research

into bone diagenesis is attempting to determine which of the two main components (protein or mineral) is most influential in determining bone survival ([Nielsen-Marsh et al, in press](#)). In the past it was believed that the mineral component was leached away, leaving the protein matrix ([Garland & Janaway, 1989](#)). Recent studies have shown that once the protein-mineral bond has been broken the protein component is leached away more rapidly, leaving the brittle mineral component ([Nielsen-Marsh et al, in press](#)). It is possible that different burial environments will determine which component of the bone is affected first.

The diagenesis of inhumations is very dependent on soft tissue decay, since people usually bury corpses, not defleshed skeletons. Hence it is difficult to say when exactly bone degradation begins ([Garland & Janaway, 1989](#)). Soft tissue decay is influenced by the cause of death, the interval between death and burial, the pre-burial treatment of the body, and factors of the burial environment affecting short term preservation ([Garland & Janaway, 1989](#)). Temperature and oxygen levels are more influential than soil type and ground water in the rate of decay of soft tissues ([Henderson, 1987](#)). However, when comparing the survival of bone in different burial environments over archaeological time-scales, it has to be assumed that the variables affecting soft tissue decay are likely to have been similar, or that their influence on long-term bone decay would have been minimal.

Bone preservation is influenced by both intrinsic and extrinsic factors. Intrinsic factors include the chemistry, size, shape, structure and density of bone, along with pathological changes to bone structure. Extrinsic factors include ground water, soil type, temperature and air, along with the nature of local flora and fauna, and human activity ([Henderson, 1987](#); [Galloway et al., 1997](#); [Gill-King, 1997](#)). Of all the intrinsic factors, bone mineral density is considered to be the most significant ([Galloway et al., 1997](#)). Soil chemistry is believed to be the most influential extrinsic factor in bone diagenesis, once all the soft tissue has been lost ([Garland & Janaway, 1989](#)).

Soils are made up of mineral and organic matter, water and air, with differing soil types composed of differing ratios. In archaeology, soil is often classified according to particle size, as clay, silt, sand and gravel ([Janaway, 1996](#)). The pH of soil has the biggest influence on bone preservation ([Gordon and Buikstra, 1981](#)), with preservation generally better in soils with a neutral or slightly alkaline pH. Acidic, free draining soils such as sand and/or gravel result in bad archaeological preservation of bone. This may be so extreme that human remains are only detectable as shadows in the sand, as seen at Sutton Hoo ([Henderson, 1987](#); [Waldron, 1987](#); [Janaway, 1996](#)). Despite this, preservation of bone may be contrary to expectation, if this prediction was based on soil types alone. Well preserved bone has been recovered from soils where bad preservation was predicted ([Henderson, 1987](#); [Waldron, 1987](#)), and can also vary among burials from the same site ([Henderson, 1987](#); [Nielsen-Marsh et al., in press](#)). Despite this huge variation in bone preservation, and the evident need to describe the bone preservation at each site, there is little standardisation in the archaeological literature on the preservation of bone ([Garland & Janaway, 1989](#)).

Grave depth is a variable determined by mortuary behaviour that will affect the preservation of bone. Crawford ([1999](#)) postulates that Anglo-Saxon children may have been buried in shallower graves than adults, as small shallow graves are much more practical to dig than small deep graves. This could be interpreted as a difference in burial rite. At shallow levels the corpse is more likely to be detected and disturbed by scavengers ([Rodriguez, 1997](#)). Indeed, modern experiments on decay using pigs have been hampered by foxes and dogs disturbing the remains (Janaway, *pers. comm.* 1999). Carnivores and small burrowing animals may remove or disturb bone, or

destroy it by gnawing, which may cause the bone to be more susceptible to decay ([Henderson, 1987](#)). Gill-King ([1997](#)) records that in cases of scavenging by animals it is often the smaller bones that are disturbed, and the spongy, marrow rich bone that is generally preferred for gnawing. It is also possible that bone from shallow graves may be damaged and lost due to modern ploughing ([Evison, 1987](#), cited in [Lucy, 1994](#); [Mays, 1998](#)). Scull ([1997](#)) noted that at the Watchfield cemetery in Oxfordshire, many juvenile graves were shallower than those of adults, and were therefore more likely to be damaged by ploughing or machine stripping before archaeological excavation.

Bone survival is also dependent on the processes of excavation, recovery, cleaning and curation, when small bones in particular are likely to be lost ([Henderson, 1987](#); [Galloway et al., 1997](#)). Waldron ([1987](#)) found that the bones most frequently missing from adult skeletons from the Romano-British site at West Tenter Street in London, were small bones such as phalanges, carpals and the coccyx, recovered in less than 20% of the sample. Small tarsals, and patellae are also infrequently recovered ([Waldron, 1987](#)). Bones that resisted destruction most were dense and heavy, including the temporal and mastoid in the skull, the mandible, thicker parts of the pelvis and dense long bones. This reveals an overall trend of the preservation of dense, heavy bones with a higher ratio of cortical to cancellous bone, over small, less dense and fragile bones ([Waldron, 1987](#); [Garland and Janaway, 1989](#)). It remains unknown to what extent this pattern is due to the failure of excavators to recognise smaller bones, rather than actual bone survival ([Waldron, 1987](#)). Whilst it seems reasonable that juvenile skeletons may be somewhat incomplete, it seems unlikely that entire skeletons could be completely missed by excavators. However, at the Winchester Minster excavations it was noted that certain excavators rarely recovered the graves of children, despite a high frequency of juveniles at the site (Kjølbye-Biddle, *pers. comm.* 1999).

The Preservation of the Bones of Children.

The bones of children are both smaller and less dense than adult bone. Consequently the arguments outlined above would imply that they are more prone to destruction than adult skeletons.

Small burrowing animals, worms and root action may disturb bones, with small bones and isolated teeth being dispersed through a large area ([Henderson, 1987](#); Chamberlain, *pers. comm.* 1999). This process may seriously affect the level of bone preservation for a site. However it seems unlikely that such disturbance could cause an entire juvenile skeleton to be lost.

In their study of animal bones Von Endt and Ortner ([1984](#): 252) found that ‘bone size and both external and internal surface area (porosity) available to groundwater’ affect the rate of bone decay. The bones of children are not only much smaller than adult bones, but are also much more porous, and have a high collagen content. This higher collagen content also affects preservation, and makes them more liable to decay, especially in acidic soils ([Gordon & Buikstra, 1981](#)). It was found that ‘at marginal pH ranges all or most of the infants and children may be systematically eliminated from the mortuary sample by preservational bias’ ([Gordon & Buikstra, 1981](#): 569). This was due to the rapid disintegration of incompletely calcified bones ([Gordon & Buikstra, 1981](#)). However, if bone preservation is generally good, then the remains of children are usually recovered, with no systematic bias apparent ([Saunders, 1992](#); [Mays, 1998](#)).

Lucy (1994) argues against this, as Molleson and Cox record good preservation of juvenile bone at Christ Church, Spitalfields, indicating that high collagen levels alone are not accountable for bad preservation of the bones of children. However, the skeletons from Christ Church, Spitalfields were recovered from an 18th-century crypt containing intra-mural burials (Molleson & Cox, 1993). Such a different burial environment cannot be used to support the argument that the bones of children do survive well in an inhumation cemetery, as the bones were not in contact with soil, acidic or otherwise. The crypt will also have provided protection from water, which, combined with an acidic soil, would have caused the bones to decay.

Walker *et al.* (1988) also noted that poorly calcified remains of children are more susceptible to decay. The authors looked at the demographic profile of an excavated 19th-century site in California, and found that although documentary evidence stated that 32% of burials in the cemetery were of people under the age of 18 years, only 6% (just 2 burials) were of sub-adults (Walker *et al.*, 1988). This poor preservation was attributed to the sandy soil of the cemetery (Walker *et al.*, 1988). It appears likely that the acidic nature of the soil had weakened the protein-mineral bond, enabling the collagen to be leached away, hence facilitating the ‘disintegration of fragile bones’ (Walker *et al.*, 1988: 184). On a second site, with slightly better bone preservation, they found that ‘infants, children and the elderly are the least well preserved’ (Walker *et al.*, 1988: 186).

The Preservation of the Remains of Children in Anglo-Saxon Cemeteries.

The evidence discussed above seems to indicate that the remains of children are particularly susceptible to decay, and that the acidity of soil is a paramount factor affecting their preservation. This paper will now assess the evidence from a selection of Anglo-Saxon sites, to determine if there is a discernible relationship between soil type and the preservation of the remains of children. As some sites have been shown to have excellent bone preservation when poor preservation was expected, the state of the preservation of adult remains will be taken as an indicator of the level of bone preservation at the site. There is little standardisation in the archaeological literature concerning levels of preservation, so this analysis is dependent on comments by the excavators and osteologists working with the bones regarding the level of preservation, which at best are vague and subjective.

The sites have been divided into early, middle and late periods, in reference to the changes in burial practice during the Anglo-Saxon period. The early phase of Anglo-Saxon burial begins in the 5th century, and continues until the early 7th century, when changes in burial rites commonly attributed to the conversion to Christianity occurred. Later Anglo-Saxon cemeteries, from the 8th century onwards, are often associated with a church. The intervening period, from the mid-7th to mid-8th century will be referred to as the mid-Saxon period. Due to the abundance of excavated and published early cemeteries, there are many more data available for analysis than for the middle and late periods. The data obtained from the earlier cemeteries are summarised in [Table 2](#), below, and the data for the middle and late Anglo-Saxon period are summarised in [Table 3](#).

Table 2: Summary of Data for Early Anglo-Saxon Cemeteries.

Site	County	Date	Soil type	Preservation of skeletal remains	% of skeletons under 5 years	% of skeletons under 12 years	References
Beckford A	Worcs.	late 5 th to mid 6 th	sand and gravel	'moderate'	[1/24] 4.2%	[5/24] 20.8%	Evison & Hill, 1996
Beckford B	Worcs.	late 5 th to mid 6 th	sand and gravel	'decomposed'	[7/108] 6.5%	[19/108] 17.6%	Evison & Hill, 1996
Bergh Apton	Norfolk	'early'	gravel	'very poor'		[12/63] 19%	Green & Rogerson 1978
Berinsfield	Oxon.	mid 5 th to early 7 th	gravel	good to excellent	[13/108] 12%	[30/108] 27.8%	Boyle <i>et al.</i> 1995
Broughton Lodge	Notts.	late 5 th to early 7 th	chalky boulder clay	'fair preservation', but not all bone curated	[5/105] 4.8%	[12/105] 11.4%	Kinsley 1993
Butler's Field	Gloucs.	mid 5 th to late 7 th	gravel	well preserved	[42/222] 18.9%	[67/222] 30.2 %	Boyle <i>et al.</i> 1998
Castledyke South	N. Lincs.	late 5 th / early 6 th to late 7 th	mostly chalk, some sandy loam	range from poor to good	[14/200] 7%	[26/200] 13%	Drinkhall & Foreman 1998

Edix Hill	Cambs.	6 th to 7 th	chalk	excellent	[15/148] 10.1%	[29/148] 19.5%	Malim & Hines 1998
Empingham II	Rutland	late 5 th to early 7 th	sand	'rather poor'	[11/150] 7.3%	[24/150] 16%	Timby 1996
Great Chesterford	Essex	5 th to 7 th	sand and gravel	good preservation	[67/167] 40.1%	[79/167] 46.7%	Evison 1994
Morning Thorpe	Norfolk	'early'	sandy gravel	very poor - bone only present in 32% of graves	[2/94] 2.1%	[9/94] ⁵ 8.5%	Green <i>et al.</i> 1987
Norton	Cleveland	6 th to 7 th	sand and gravel	varied preservation	[5/126] 4%	[23/126] 18.2%	Sherlock & Welch 1992
Portway, Andover	Hants.	'early'	chalk	mostly poor condition	[7/69] 10.1%	[19/69] 27.5%	Cook & Dacre 1985
Sewerby	E. Yorks.	late 5 th / early 6 th to 7 th	sand and gravel	varied from poor to good	[3/59] 5.1%	[9/59] 15.2%	Hirst 1985
Spong Hill	Norfolk	5 th to 6 th	sand and gravel	most bones destroyed		[3/58] 5.1%	Hills 1977; Hills <i>et al.</i> 1984
West Heslerton	N. Yorks.	5 th to mid 7 th	sand and gravel	varied, but generally poor	[11/184] 6%	[22/184] 12%	Lucy 1994; Powlesland <i>et al.</i> 1986; Powlesland 1987

Westgarth Gardens	Suffolk	'early'	sand and heavy gravel	'good to none existent'	[4/59] 6.8%		West 1988
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Table 3: Summary of Data Collected from Middle and Late Anglo-Saxon Cemeteries.

Site	County	Date	Soil type	Preservation of skeletal remains	% of skeletons under 5 years	% of skeletons under 12 years	References
Castle Green	Hereford	8 th to 12 th	clay	fair preservation	[23/102] 22.5%	[29/102] 28.4%	Shoesmith 1980
Didcot	Oxon.	7 th C.	sandy gravel	generally poor	[1/17] 5.9%	[3/17] 17.6%	Boyle <i>et al.</i> 1995
Norwich Castle	Norfolk	'late Saxon'	chalk	bone generally survived well	[50/112] 44.6%	[64/112] 57.1%	Ayers 1985
Raunds	Northants.	10 th to 12 th	clay and limestone	particularly good	[124/328] 37.8%	[151/328] 46%	Boddington 1996
Winnall II	Hants.	7 th C.	chalk	reasonable preservation	[4/44] 9.1%	[8/44] 18.2%	Meaney & Hawkes 1970
Winchester	Hants.	late 7 th to mid 9 th	chalk and clay	reasonable to very good		[83/219] 37.4%	Kjølbye-Biddle <i>unpub.</i>
Winchester	Hants.	mid 9 th to late 10 th	chalk and clay	reasonable to very good		[188/373] 50.7% ⁹	Kjølbye-Biddle <i>unpub.</i>

Discussion of Results.

Overall, very few infant remains were recovered from many of the early sites. The average number of children under the age of 5 was 9.7%, and 19.3% for under 12 years. Most of these earlier cemeteries (12/16) were on sandy or gravel soils, both of which are believed to be poor preservers of bone, due to their acidic pH. The preservation of adult bone was taken as an indicator for the level of bone preservation on the different sites. This was frequently regarded as 'poor', 'moderate' or 'fair'. The exceptions to this rule were Berinsfield and Butler's Field, where bone preservation was considered to be 'good to excellent' and 'well preserved' respectively. Both of these sites reveal larger frequencies of recovered bones of children.

The most startling site for this period was Great Chesterford, where 40.1% of burials were of children under the age of 5 years, despite the sandy gravel soils at the site. Lucy (1994) and Crawford (1999) both noted this cemetery for the high numbers of graves of children, but although they noted that these figures are nearer those expected for a pre-industrial society, a cultural explanation for this phenomenon was not suggested by either author. Preservation at this site was only described as 'good' rather than 'excellent'. However, as the terminology used to describe bone preservation is rarely quantified, and is highly subjective, it is possible that the 'good' used to describe the bone recovered at this site was of a similar condition for a site where 'excellent' preservation was noted. This highlights the need for standardisation of terms in archaeological literature. Mays (1998) noted that sites with good bone preservation generally do not have problems with under-representation of the remains of children.

Broughton Lodge, Castledyke South, Edix Hill and Portway Andover were all situated on chalky soil. These sites show a range of preservation from 'poor' to 'good', with Edix Hill and Portway having slightly higher than average frequencies of child burials.

The numbers of sites with enough published data to be included in this study is much lower for the middle and late Saxon periods. Two 7th-century cemeteries, Didcot and Winnall, are published with the skeletal analysis included in the report. Didcot had a very small skeletal sample due to the nature of the excavations, and these were found to be poorly preserved, with few juveniles represented. This would be expected, as the site was on sandy gravel. The soil at Winnall was chalky, and slightly more remains of children were recovered, again following the pattern of bone survival apparent from the earlier cemeteries.

Only four cemeteries from the later Anglo-Saxon period were available for this study. These sites show a higher level of infant burial, and again the preservation of bone at these sites was regarded as fair to very good. These profiles ranging from 28.4 to 50.7% of burials under the age of 12 are much nearer to the figures expected for a pre-industrial society. These sites were located on chalk and clay, which supports the earlier hypothesis that preservation, which is dependent on soil type, is a major factor in the recovery of the remains of children.

Another factor that should be taken into account is the date of publication for the cemetery reports. Juvenile burials were given a lower priority in earlier excavations, as their skeletons were considered to yield little useful information for the osteologist. Consequently the remains of children were often left unexcavated (Humphrey, *pers. comm.* 1999), or were given low priority during curation and publishing (Chamberlain, *pers. comm.* 1999). The data given in [Table 4](#), below, are the summarised percentages of graves of children according to decade of publication (taken from [Tables 2](#) and [3](#), above).

Decade of Publication	Early Cemeteries		Mid-Late Cemeteries	
	Under 5	Under 12	Under 5	Under 12
Average	[207/1823] 11.4%	[388/1885] 20.6%	[202/603] 33.5%	[526/1195] 44%
1970s	No data available	[12/63] 19%	[4/44] 9.1%	[8/44] 18.2%
1980s	[27/465] 5.8%	[62/464] 13.4%	[73/214] 34.1%	[93/214] 43.5%
1990s	[180/1358] 13.3%	[314/1358] 23.1%	[125/345] 36.2%	[425/937] 45.4%

Table 4. Percentage of Juveniles Recovered According to Decade of Publication.

This shows that for both the early and the mid-late cemeteries there is tendency for the numbers of juveniles recovered to increase over time. The increase is more marked for the percentage of individuals under five years. This may indicate an increasing awareness on the behalf of the excavators regarding the importance of the remains of children. However, it may also reflect that during earlier excavations, graves containing larger amounts of grave goods (usually the graves of adults) may have been prioritised, and is a reflection of the change from selective to total excavation. The combination of these factors would have compounded the issue. This would also explain the higher percentages of juvenile burials recovered for the middle and later cemeteries, which usually contained few or no grave goods. Naturally the dates given above are for publication, not for excavation. Given that many sites are not published for decades after excavation, a survey collecting excavation dates, and also including some earlier sites when the curation of bone was regarded as less important, would be interesting.

The so-called ‘invisibility’ of children (and women) in archaeological studies, which saw male adults as the norm, further complicates these issues ([Scott, 1997](#)). This archaeological invisibility seems inexplicable, as children obviously contributed both to the societies in which they lived, and the archaeological record ([Chamberlain, 1997](#); [Sofaer Derevenski, 1997](#)). The main reason for this lack of interest in the archaeology of children was often given as the lack of surviving remains ([Moore, 1997](#)). Where remains do survive in any great quantity, interpretations of infanticide are particularly popular ([Moore, 1997](#); [Scott, 1997](#)).

However, this theoretical problem of invisibility is not only a consequence of taphonomic processes biasing demographic samples, but may have been aggravated by the lower priority afforded to juvenile graves on earlier excavations. The increase seen in the recovery of the remains of children in more recent excavations is at least

in part due to the increasing awareness that children have been rendered archaeologically invisible, a theoretical development which dates to the later 1990s. Until more archaeologists become interested in children, and include them in their narratives, the remains of children will continue to be put on the back bench of archaeological analysis, even for cemetery sites where their remains are well preserved. Those theoreticians who do currently 'write children' into archaeology need to be made fully aware of the implications of bone diagenesis and the under-representation of children in cemeteries of all periods.

Conclusions.

This paper has highlighted a number of major problems in the archaeological literature. Firstly, more sites need to be published, so that the data are more readily available. The reports published need to standardise the data included, and osteological analyses should not only be included, but included as part of the main body of the report, rather than as an appendix or on microfiche. It is also apparent that trained osteologists are needed on archaeological excavations if all of the bone present is to be recovered, and hence have a more complete skeletal sample to work from.

It is evident that small, porous bones, and those with high collagen contents, (which are characteristics of juvenile bone) are particularly prone to decay. Smaller bones are also more prone to recovery bias during excavation, and it may be possible for excavators to miss completely the burial of a small child or infant, especially if the bones are poorly preserved, and the excavator is inexperienced at identifying and excavating human remains.

Although the bones of children can be perfectly preserved under optimal conditions, when these conditions are less conducive for bone preservation in general, juvenile bones are much more prone to loss than those of adults. Acidic, sandy or gravel soils are considered to be the worst for bone survival, causing even entire adult skeletons to be lost.

This study has revealed a general relationship between the level of bone preservation and the proportions of children recovered from a site during the early Middle Ages. Children were found to be highly under represented in cemeteries located on sandy or gravel soils during the earlier Anglo-Saxon period. During the middle and later Anglo-Saxon periods more children are recovered from cemetery sites. This, however, does not seem to reflect a change in the burial rites accorded children, but rather a change in the location, and hence the geology, of cemetery locations. This phenomenon may be connected to the shifting nature of Anglo-Saxon settlements and cemeteries ([Arnold & Wardle, 1981](#); [Hodges, 1989](#); [Hamerow, 1991](#)).

The evidence given above indicates that the under representation of the remains of children may be attributed to poor preservation. This does not, however, rule out the possibility that juveniles may have been given a different burial rite during the Anglo-Saxon period. There is only one example, to my knowledge, of juvenile remains found in non-cemetery contexts for this period. At West Heslerton in East Yorkshire around fifteen juvenile skeletons were recovered from the inside of sunken featured buildings on the settlement site ([Powlesland, 1997](#)). This type of evidence of different disposal of juvenile remains has been interpreted as evidence for infanticide during the Roman period, both in Britain and on the Continent ([Smith & Kahila, 1992](#); [Mays, 1993](#)). The evidence from West Heslerton should not necessarily be interpreted as evidence of Anglo-

Saxon infanticide, but it also should not be used as evidence that Anglo-Saxon children were normally given a different burial rite. It is possible that this site may represent some level of continuity in Romano-British beliefs, or may just reflect a local tradition. It is dangerous to apply this scenario to all early Anglo-Saxon cemeteries.

It is the case that "in preserved skeletal collections...the under-representation of immature individuals can be so great that little evidence remains regarding the original age structure of the burial population" ([Walker et al., 1988](#): 188). This certainly appears to be true for many cemeteries dating to the early Anglo-Saxon period. It must be remembered that an absence of evidence is not necessarily evidence of absence. The issue of the preservation of the remains of children must be addressed before a range of cultural explanations are suggested regarding the frequency (or absence) of juvenile burials at any cemetery site.

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