

## 5. THE HUMAN REMAINS AND THE CEMETERY DEMOGRAPHIC PROFILE

A total of 81 individuals were interred at the site, including 71 articulated human skeletons, five sets of disarticulated human remains (Sk133, Sk144, Sk165, C306, C310), three coffins with no human remains (Coffins C116, C171 and C273), and two coffins that were left in situ on the site due to their location (Table 1).

The completeness of the skeleton and the surface preservation of the bones was recorded using Brickley and McKinley's grading system (Brickley and McKinley 2004: 16, figure 7.1-7). Age estimation of adults relied on the analysis of dental attrition (Anderson et al 1976; Brothwell 1981: 72; White & Folkens 2005: 346; Lovejoy et al 1985a & 1985b) and the analysis of the auricular surfaces of the ilium, where available (Lovejoy et al 1985b; Buckberry & Chamberlain 2002; White & Folkens 2005: 358). It was necessary to rely on the grading of dental attrition for many of the human skeletal remains as in many instances the *os coxae* had not survived the waterlogged burial environment. It was not possible to use sternal rib end or pubic symphyseal analysis for age estimation. Non-adult age estimation relied upon epiphyseal fusion stages from standards published in Scheuer & Black and Schaefer et al (Scheuer & Black 2000, 2004; Schaefer et al 2009) as well as dental development and eruption stages (Gustafson & Koch 1974).

Sex determination of adults was analysed using standards published in Brothwell, Ubelaker, Bass and Mays; sex determination of non-adults was not carried out due to continuous osteon remodelling and rapid skeletal growth (Brothwell 1981; Ubelaker 1989; Mays 1998; Mays 2010; Bass 1987; Bass 1995). Cranial and post-cranial non-metric and metric traits were recorded (Trotter & Gleser 1958; Berry & Berry 1967; Trotter 1970; Howells 1973; Finnegan 1978) as well as unusual enthesal changes and pathological conditions for both dentition and bone (van Beek 1983; Hawkey & Merbs 1995: 326; Roberts & Manchester 2010; Davis et al 2013; Henderson et al 2016).

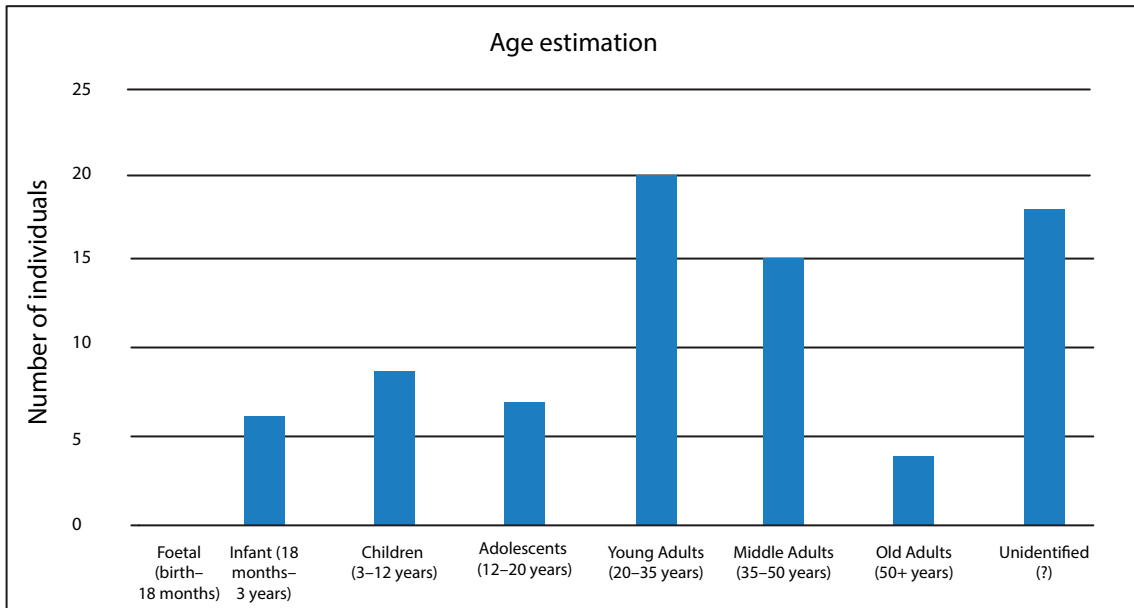
The preservation of the human skeletal remains was very poor in the main; the waterlogged burial environment had a detrimental impact on the human remains, damaging all aspects of the bone.

The damage caused to the cortical bone surfaces had a negative impact on sex determination, age estimation, stature estimation and examinations for pathological conditions. Most of the human bone was graded either Very Poor or Poor (Brickley and McKinley 2004: 16, figure 7.1-7). The completeness of the skeletons ranged from 5% to 75%.

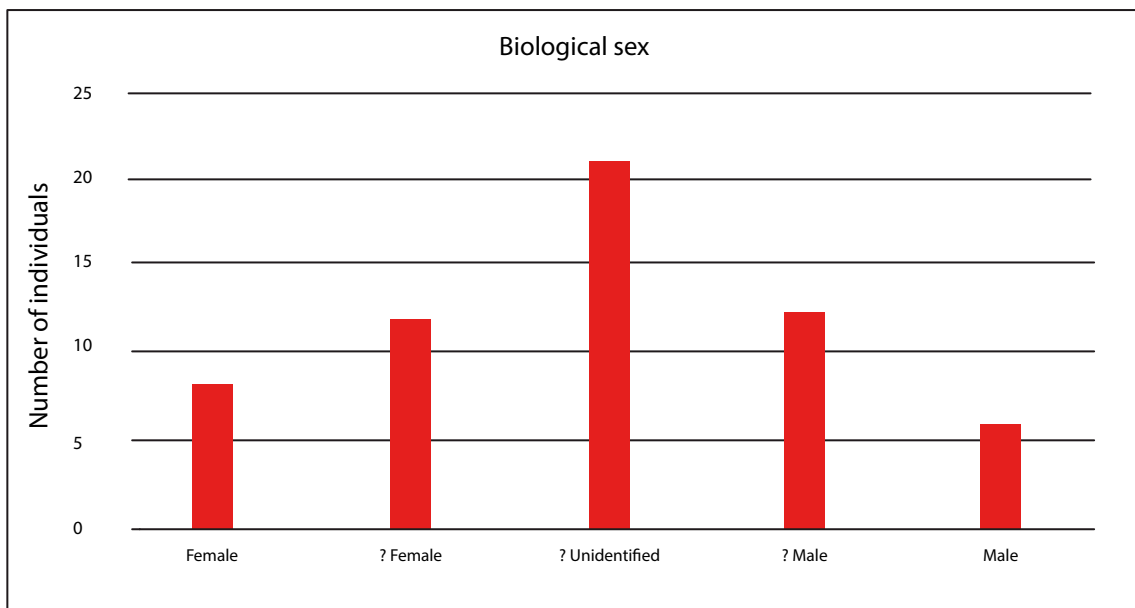
Adults represent 68.3% of the cemetery population while non-adults (including sub-adults) represent 31.7% of the population (Illus 5). It was necessary to assign broad age categories due to the poor condition of the human remains. Adult individuals were defined by the presence of complete dental eruption and complete epiphyseal limb bone fusion centres (Ruff et al 2012: 603). Non-adult individuals were defined by the presence of incomplete dental eruption and incomplete epiphyseal fusion centres. Young Adults (20–35 years) are the largest age group at 25.3%, closely followed by Middle Adults (35–50 years, 18.9%), Unidentified (22.7%) and Children (3–12 years) (11.3%). Adolescents/Sub-adults (12–20 years) make up 8.8% of the assemblage and Infants (18 months–3 years) make up 7.5%. Old Adults (50+ years) make up 5% of the assemblage. There were no neonatal individuals (birth–18 months). Over a fifth of the burials could not be assigned an age due to poor preservation.

Just under two-thirds of the adult skeletal remains could be assigned a biological sex. When pooled, division of the sexes appears fairly equal; female/possibly female individuals comprised 33.8% of the total population and male/possibly male individuals comprised 30.4% of the total adult population. Over a third of the adult population could not be assigned a sex (Illus 6).

In terms of the cemetery demographic, important interpretations can be drawn from comparisons to other medieval and post-medieval cemeteries in Britain. Two types of mortality profiles can be identified with cemetery populations: attritional and catastrophic. The former is a mortality profile derived from natural wastage and is characterised by a high number of infant deaths, a low number of adolescent deaths and a gradual increase in mortality (Gowland & Chamberlain 2005: 146). The catastrophic palaeodemographic profile is characterised by a short-term mortality crisis as a consequence of disease, war, massacre and famine



Illus 5 Age estimation © Wardell Armstrong LLP



Illus 6 Sex estimation © Wardell Armstrong LLP

**Table 1** Catalogue of human skeletal remains

Skeleton no./ Context no.	Cur no.	Coffin no.	Finds	Alignment	Age (adult/ non-adult)	Refined age	Sex	Height (cm & ft/in)	Measurements (mm) (cranial)	Pathologies (bone)	Pathologies (dentition)
133	132	-	-	Disartic.	Adult?	-	-	-	-	-	-
144	119	-	-	Disartic.	?	-	-	-	-	-	-
127	122	123	SFs 1-7 & 69, Fe nails <5>	N-S	Adult	40+ yrs	?	165.79-169.15 (5ft 5-5ft 6)	-	Periosteal new bone - occipital fragment	Caries on occlusal surface of LM <sup>2</sup> , slight calculus
150	141	142	None	E-W	Adult	-	?F	-	-	-	-
151	119	121	SF8, Fe nail	E-W	Non-adult	10-12 yrs	?	-	-	-	-
165	164	-	-	Disartic.	Adult	-	-	-	-	-	-
166	149	147	SFs 68 & 73, Fe nails	N-S	Adult	-	?	-	-	Porotic hyperostosis on cranium, kidney stone <22>	Slight calculus, LEH on 4 teeth
210	203	204	None	N-S	Non-adult	6 yrs	?	-	-	-	LEH on 3 teeth
221	196	-	SF9, Fe nail	E-W	Adult	-	?	175.13-179.21 (5ft 7-5ft 8)	-	Pronounced <i>Linea aspera</i> & platymeria	-
271	260	261	None	E-W	Non-adult	2-3 yrs	?	-	-	-	-
279	234	240	None	E-W	Adult	20-30 yrs	?M	179.25 (5ft 8)	-	-	LEH on 10 max teeth, large caries on RM <sup>2</sup> , slight calculus on 6 teeth; mandible: slight calculus on all dentition, LEH on 3 teeth
284	253	237	None	E-W	Adult	25-35 yrs	?M	-	-	Exostoses on cost-clav lig; porotic hyperostosis on cranial vault	Periodontal disease on mandible, slight calculus on 15 teeth; LEH on 9 teeth including mand incisors, max PMs and max canine
306 (C no.)	305	-	None	Disartic.	Adult	-	-	-	-	-	-
310 (C no.)	303	-	None	Disartic.	Adult	-	-	-	-	-	-

Table 1 cont

Skeleton no./ Context no.	Cut no.	Coffin no.	Finds	Alignment	Age (adult/ non-adult)	Refined age	Sex	Height (cm & ft/in)	Measurements (mm) (cranial)	Pathologies (bone)	Pathologies (dentition)
318	233	300	None	E-W	Non-adult	4 yrs	?	-	-	-	LEH on all max incisors plus 2 mand incisors
351	336	339	None	N-S	Adult	17-25 yrs	?	-	-	-	-
356	352	354	None	E-W	Non-adult	18 mths-3 yrs	?	-	-	Body non-existent	24 teeth; notches on occlusal incisors (normal variant), possible LEH on incisors
361	329	330	None	E-W	Adult	25-35 yrs	?	162.78-167.31 (5ft 3-5ft 4)	-	-	Slight calculus on M <sub>2</sub> , LEH exhibited on 4 teeth
365	363	364	SFs 10 & 11, Fe nails	E-W	Adult	50+ yrs	M	183.57 (6ft)	-	Healed fracture to R clavicular shaft; osteophytic changes on L vert, rugose pitting at <i>Biceps brachii</i> , acetabular pitting (osteophytic changes), destructive lesion in posterior navicular – gout?, R patella – osteophytic changes	Heavy calculus & periodontal disease on mand teeth, large caries on occlusal surface of RM <sub>1</sub> ; heavy calculus on M <sub>2</sub> and canine
382	337	380	None	N-S	Adult	25-35 yrs	?	-	-	Hydatid casing	Mandible: all present and correct; moderate calculus on incisors, slight calculus on canines & molars; LEH on 2 incisors, both canines and PM <sub>1,s</sub>

Table 1 cont

Skeleton no./ Context no.	Cut no.	Coffin no.	Finds	Alignment	Age (adult/ non-adult)	Refined age	Sex	Height (cm & ft/in)	Measurements (mm) (cranial)	Pathologies (bone)	Pathologies (dentition)
389	372	374	SF62 wooden rosary/paternoster beads <117>	E-W	Adult	27-35 yrs	M	181.53 (5ft 11)	-	A chap with many pathologies; grade 1 osteophytic lipping on 5 T, 2 L & 2 C vert; high % of Schmorl's Nodes on T vert – largely on inferior surface but 4 T vertebrae display nodes on both surfaces; large depression at site of deltoid on L humerus – possible soft tissue injury; wormian bones	LEH on all incisors and PM <sub>1</sub> ; maxillary dentition: all except LM <sub>3</sub> ; slight to moderate calculus on incisors, no caries, minor periodontal disease. Mand dentition: all except M <sub>3</sub> ; slight calculus, no caries, minor periodontal disease; individual would have had an overbite
396	391	392	None	E-W	Adult	33-45 yrs	?M	-	-	-	Slight calculus on 5 max teeth
397	367	369	None	E-W	Adult	20-29 yrs	F	-	-	Wormian bones, tumour on R mastoid process – mastoid osteoma	Very slight calculus, minor periodontal disease – teeth in quite good condition
399	383	398	None	E-W	Adult	50-60 yrs	F	-	-	None observed – bone preservation too poor	AMTL on tiny mandible; no dentition; likely quite an elderly individual
402	400	401	None	E-W	Non-adult	18 months-2 yrs	-	-	-	None	None
409	417	394	None	E-W	Adult	42-45 yrs	F	157.84cm (5ft 2)	-	None observed	PM <sub>2</sub> & M <sub>2</sub> ; mand dentition: LEH on 5 teeth (incisors & canine); slight calculus on molars and incisors; heavy calculus on max teeth

Table 1 cont

Skeleton no./ Context no.	Cut no.	Coffin no.	Finds	Alignment	Age (adult/ non-adult)	Refined age	Sex	Height (cm & ft/in)	Measurements (mm) (cranial)	Pathologies (bone)	Pathologies (dentition)
411	405	407	None	E-W	Non-adult	10-12 yrs	-	-	-	-	LEH evident on all max incisors, 2 mand incisors & max L canine
422	413	423	None	E-W	Adult	30-35 yrs	F	160.31cm (5ft 3)	-	Potential kidney stone, hydatid cyst; potential destructive lesion on posterior surface of T10 vert - beginnings of TB?; heavy exostoses at both <i>Biceps brachii</i> sites on radii	Slight calculus on 7 max teeth and 4 mand teeth, some AMTL at site RM <sub>1</sub>
430	491 [pit]	-	SFs 12 & 13; Fe key plus 3 coins in corrosion	N-S	Adult	45-55 yrs	?M	-	-	None observed	Extensive periodontal disease on mand dentition, slight calculus on 4 max & 3 mand teeth, very heavy wear
432	426	424	None	E-W	Adult	18-22 yrs	?F	147.96cm (4ft 10)	-	Mand torus present	Very slight calculus on mand dentition (teeth include all L side teeth from LI <sub>1</sub> )
435	433	434	None	E-W	Adult	45-55 yrs	M	183.57cm (6ft)	-	None observed	Heavy calculus on max teeth, heavy calculus on mand teeth, caries on M <sub>2</sub> and M <sub>3</sub>
438	418	420	None	E-W	Adult	24-30 yrs	?F	152.90-158.33cm (5ft-5ft 2)	-	Scurvy on cranium? Very thick cranial vault, very thin cortical bone	LEH on 7 mand teeth
439	415 [pit]	-	None	N-S	Sub-adult	16-20 yrs	?	-	-	None observed	LEH on mand incisors; deciduous max & molars present

Table 1 cont

Skeleton no./ Context no.	Cur no.	Coffin no.	Finds	Alignment	Age (adult/ non-adult)	Refined age	Sex	Height (cm & ft/in)	Measurements (mm) (cranial)	Pathologies (bone)	Pathologies (dentition)
440	415 [pit]	-	SFs 43 & 44 leather boots with wooden soles	E-W (cranium at E end)	Adult	-	?	Fem L: 403mm; 153.6-157.2cm (5ft-5ft 1)	-	None observed	None
441	415 [pit]	-	SF60 wooden bead <60>	E-W (cranium at E end)	Sub-adult	15-17 yrs	?	-	-	Lesions & pitting in 3 C vert – possibly infection	None
442	415 [pit]	-	None	E-W	Adult	44-47 yrs	?M	161.79cm (5ft 3)	-	Periosteal infection on lateral distal R humerus, slight osteophytic changes on T vertebrae, Schmorl's Nodes on 3 T vert	Slight to moderate calculus on molars, caries on LPM <sup>2</sup> , periodontal disease evident on mandible; very heavy wear on mand canines & incisors (posterior/lingual)
443	415 [pit]	-	Leather from torso	E-W	Adult	45 yrs+	?M	-	-	None observed	AMTL on mandible, caries on LPM <sub>2</sub>
449 & 529 (cranium)	516 [pit]	-	None	E-W	Adult	45-55 yrs	?M	-	ZZ: 44.64	Heavy <i>Linea aspera</i> & <i>Soleal line</i> enthesal changes on both fems & tibs	Heavy calculus evident on: mand incisors, all premolars and R canine; abscess on LM <sub>1</sub> ; caries on LM <sub>1</sub> ; heavy calculus on all left max dentition; periodontal disease evident on both max & mand dentition
453	450	454	SF14 (Fe nail)	N-S	Non-adult	4-6 yrs	?	-	-	-	LEH on 2 incisors
460	458	-	None	E-W	Adult	18-22 yrs	?	-	-	-	-
461	459	-	None	-	Non-adult	6-7 yrs	-	-	-	-	None

Table 1 cont

Skeleton no./ Context no.	Cut no.	Coffin no.	Finds	Alignment	Age (adult/ non-adult)	Refined age	Sex	Height (cm & ft/in)	Measurements (mm) (cranial)	Pathologies (bone)	Pathologies (dentition)
462	463	446	None	N-S	Adult	40-50 yrs	?F	-	-	-	Caries on M <sub>2</sub> , heavy calculus on mand teeth, slight calculus on max teeth
472	470	471	None	E-W	Adult	45-55 yrs	?	-	-	-	None
477	415 [pit]	-	None	E-W	Adult	40-50 yrs	?F	160.31cm (5ft 3)	-	Fusion of acetabulum & L prox fem head	Moderate calculus on 8 teeth, slight calculus on 6 max teeth, LEH on 3 incisors
478	415 [pit]	-	None	NE-SW in pit	Adult	40-45 yrs	?F	160.13cm (5ft 3)	-	Schmorl's Node on T9, lesion in T10	Moderate calculus on all mand molars; LEH on 2 mand incisors
479	415 [pit]	-	None	E-W	Sub-adult	14-16 yrs	?	-	-	-	Very healthy teeth
480	415 [pit]	-	None	E-W	Adult	24-30 yrs	?M	-	-	Destructive lesion in glenoid fossa portion - tuberculosis?	Moderate calculus on max molars (x3)
481	415 [pit]	-	Leather; SF70 sewing kit; SF66 wood pommel top	E-W	Non-adult	11-12 yrs	-	-	-	None observed	Note: eruption of LPM <sub>1</sub> not quite complete
482	415 [pit]	-	SF41 leather & woollen shroud material	SW-NE in pit	Adult	30-40 yrs	?F	157.05cm (5ft 1)	-	Lesion on external cranial vault, possible PH?	Heavy calculus on mand dentition; periodontal disease



**Table 1 cont**

Skeleton no./ Context no.	Cut no.	Coffin no.	Finds	Alignment	Age (adult/ non-adult)	Refined age	Sex	Height (cm & ft/in)	Measurements (mm) (cranial)	Pathologies (bone)	Pathologies (dentition)
483	415 [pit]	-	SF42 pin from R scap; SF63 wood lice comb; woollen shroud material, SF61 wooden beads <265>	SW-NE in pit	Adult	24-25 yrs	F	152.30cm (4ft 11)	-	Matching bony nodules on conoid tubercles (clavicles); natural bone formation (clavicle not fused, under 26 yrs; wear on R max molars = 24-30 yrs; evidence of shroud and clothing on virtually all bones	Heavy wear on all dentition, slight calculus on mand dentition; evidence of periodontal disease on both max and mand dentition
484	415 [pit]	-	Woollen shroud material <258>	SW-NE in pit	Adult	20-24yrs	?F	149.9cm (4ft 11)	-	Medial squatting facet on L talus	AMTL on LM <sub>1</sub> ; moderate calculus on mand teeth
485	455	457	None	E-W	Sub-adult	c 13 yrs	?	-	-	None observed	-
487	475	488	None	N-S	Adult	35-45 yrs	?	-	-	None observed	Moderate calculus on mand molars
493	491 [pit]	-	Shroud material	E-W in pit	Adult	30-35 yrs	F	157.84cm (5ft 2) L femur = 420mm	-	Lesions on cranial vault possibly associated with porotic hyperostosis	Moderate calculus on M <sub>1</sub> , M <sub>2</sub> & LPM <sub>1</sub> ; caries on LM <sub>2</sub> ; slight calculus on LPM <sub>2</sub> , moderate calculus on L mand canine
494	491 [pit]	-	Shroud material; SF71 CuA brooch	Roughly E-W in pit	Adult	35-40 yrs	?F	157.23cm (5ft 1); left tibia = 330mm & left fem prox head = 42.77mm Ø	-	-	Heavy calculus on M <sub>1</sub> & LPM <sub>1</sub> ; moderate calculus on PM <sub>1</sub> & LI <sub>1</sub>
495	491 [pit]	-	Shroud material	N-S	Sub-adult	16-20 yrs	?M	-	-	-	-

**Table 1** *cont*

Skeleton no./ Context no.	Cut no.	Coffin no.	Finds	Alignment	Age (adult/ non-adult)	Refined age	Sex	Height (cm & ft/in)	Measurements (mm) (cranial)	Pathologies (bone)	Pathologies (dentition)
498	496	497	None	N-S	Non-adult	12-24 months (2 yrs)	-	-	-	-	Possible LEH on mand incisors
501	486	489	None	E-W	Adult	-	?M	179.21cm (5ft 10)	-	-	-
502	466	468	None	E-W	Adult	-	M	R fem L: 470mm; R fem prox hd: 45.61mm, L fem prox hd: 46.08mm; Height = 174.57cm (5ft 8)	-	-	-
506	514	-	SFs15-40; 25 silver coins dating to Charles I 1637-42; leather purse/corded fragments plus partial clasp and attached bead; SF58 Fe tack/hobnail; also woollen shroud material from <255>	E-W	Adult	20-24 yrs ?	?	-	-	-	LEH on 4 max teeth and on M <sub>1</sub> and both canines
508	486?	-	None	Disartic.	Sub-adult	<19 yrs	?	-	-	-	-
511	558	-	None	-	Adult	-	?F	156.35cm (5ft 1)	-	Possible periosteal infection on R tibia	-

**Table 1 cont**

Skeleton no./ Context no.	Cut no.	Coffin no.	Finds	Alignment	Age (adult/ non-adult)	Refined age	Sex	Height (cm & ft/in)	Measurements (mm) (cranial)	Pathologies (bone)	Pathologies (dentition)
512	558	-	SF64 wooden lice comb & coins dating to James VI (florins 1567-1625); SFs48-55 - this group includes Fe handle & leather cord - purse fragments; leather/coarse fabric shroud material	E-W	Adult	-	?M	R tibia L = 380mm; 173.89cm (5ft 8)	-	Hydatid casing (tapeworm) in <312>; wormian bones; heavy exostoses on lateral distal R hum - is this a soft-tissue injury?	-
517	516	-	None	E-W	Non-adult	-	-	-	-	-	-
518 (legs) & 531 (cranium)	516 [pit]	-	None	E-W	Adult	18-22 yrs	M	Left tib = 400mm; 183.57cm (6ft)	RB <sup>1</sup> : 27.93; ZZ 38.01; H <sub>1</sub> : 28.25	None observed	Heavy calculus on mand incisors, canines & both PM <sup>1</sup> s; moderate to heavy calculus on max incisors, canines, PM <sup>1</sup> s and PM <sup>2</sup> s; LEH on mand and max incisors
519 (legs) & cranium (532)	516 [pit]	-	None	E-W	Adult	17-22 yrs	M	Right tib = 420mm, 183.33cm (6ft)	-	Wormian bones	LEH on max incisors, both canines & LPM <sup>1</sup> ; minor calculus on all mand incisors
520 (legs) & 530 (cranium)	516	-	None	E-W	Non-adult	6-7 yrs	-	-	-	Lesions on parietal possibly associated with scurvy	LEH on max incisors

**Table 1 cont**

Skeleton no./ Context no.	Cur no.	Coffin no.	Finds	Alignment	Age (adult/ non-adult)	Refined age	Sex	Height (cm & ft/in)	Measurements (mm) (cranial)	Pathologies (bone)	Pathologies (dentition)
525	522	524	SF65, <294>, wooden bead, woollen shroud material from <294>; 3 x beads from <292>	E-W	Adult	40-45 yrs	M	Fem hd: 47.54mm; no height	Gonion: 67°; RB <sup>1</sup> : 33; ML: 110; ZZ: 44; GoGo: 90; Gnathion: 56; Infradental: 53.11; H <sub>1</sub> : 32.89; Mentale (L): 75.7; Mentale (R): 73.5	Mand torus present	Moderate calculus on mand incisors, canines and PMs; heavy calculus on LM <sub>1</sub> & M <sub>2</sub> (mand); large caries on RM <sub>1</sub> (mesial)
527 & 535 (legs)	516 [pit]	-	None	E-W	Non-adult	5-7 yrs	-	-	-	-	LEH on 2 deciduous mand incisors & both permanent M <sub>1</sub> s (not quite erupted)
528 & 534 (legs)	516 [pit]	-	SF45 Fe attached to bone	E-W	Sub-adult	12-15 yrs	-	-	-	-	Slight calculus on 5 mand dentition; pronounced mesial marginal ridge on upper L canine; LEH on max canines, max incisors, mand M <sub>1</sub> s and 3 mand incisors
538	415	-	-	Disartic, no orientation (located N of Coffin C374)	Adult	-	F	Fem hd: 40.17mm	-	-	No dentition

**Table 1** *cont*

Skeleton no./ Context no.	Cut no.	Coffin no.	Finds	Alignment	Age (adult/ non-adult)	Refined age	Sex	Height (cm & ft/in)	Measurements (mm) (cranial)	Pathologies (bone)	Pathologies (dentition)
550	536	540	SFs 46 & 47 Fe coffin nails	E-W	Adult	45-55+ yrs	?	R tib L = 400mm (177.53-183.57cm 5ft 8-6ft)	-	-	Slight calculus on max incisors
551	541	542	None	E-W	Adult	-	?F	Limb bones not 100% complete	-	-	-
552	548	547	None	E-W	Adult	-	?	L fem L = 410mm & R tib L = 330mm, H = 156.06-160.33cm (5ft 1-5ft 2)	-	-	LEH on 5 mand teeth
556	558	-	-	NW-SE	Adult	<30 yrs	F	L fem = 450mm, L tib = 340mm; H = 163.01cm (5ft 4)	-	-	-
557	558	-	SF56 coin?	E-W	Adult	50+ yrs	?F	-	-	-	-

(Margerison & Knüsel 2002: 134); all age groups are affected, with an emphasis on Children and Young Adults. Excavations at the mid-14th-century plague burial site of the Royal Mint, London, produced over 1,000 skeletons, of which 600 were available for analysis (ibid: 136). The skeletons were contained within burial trenches and grave rows, and a mix of all sexes and ages were represented with no noticeable segregation of individuals (ibid). The burial methods were well organised and the bodies were interred with care; there were many juvenile individuals and very few Young Adults. The Royal Mint cemetery generally fits with a catastrophic palaeodemographic profile, as does the death assemblage from St Mary's (Leith), although there is a distinct difference in the quantity of burials ( $n = 81$  at St Mary's (Leith) as opposed to over 1,000 at the Royal Mint); all sexes and ages are represented at both with no discrimination of burial selection criteria. A disease like the plague was indiscriminate in its nature and bodies needed to be buried as quickly as possible, regardless of age, sex or social status (Ziegler 1969: 137; Hollingsworth et al 1971: 171). Well-organised and respectful burial methods are also visible in both cemeteries, although some at St Mary's (Leith) do indicate a lack of care. Juvenile individuals are frequent in both populations, although a high proportion of Young Adults are represented at St Mary's (Leith), which is more typical of a catastrophic palaeodemographic profile (Margerison & Knüsel 2002: 141).

Another London cemetery site with a catastrophic demographic profile is St Botolph-without-Bishopsgate. The death assemblage has a high prevalence of Non-adult individuals, which does match the catastrophic model, although the authors argue that no one age group is particularly susceptible to the plague and that the severity of the outbreak would be influenced by environmental factors and social customs (Hollingsworth et al 1971: 131). Similarly, the mortality profile for a 17th-century plague cemetery in Venice matches the catastrophic demographic model; the plague of 1630 wiped out a third of the population of Venice and a high proportion of Non-adults and Young Adults are represented; a histogram from this burial site shows a cluster of deaths aged from 0 to 25 years (Ell 1989: 128). Over 59% of the victims were women and, interestingly, this figure includes

a high number of pregnant women. A likely cause for this is a lowered immunological state due to the suppression of T-cell immunity (ibid: 136). This type of immunity is especially important in combating plague, and an individual with a low quantity of T cells has less chance of surviving a disease epidemic (Wake, Morita & Wake 1978: 1045–52).

In contrast, some comparisons can be drawn to cemetery populations with an attritional profile. Excavations at the 12th–16th-century urban site St Helen-on-the-Wall, York, revealed a minimum of 1,044 individuals (ibid: 137). In common with a catastrophic cemetery profile, all ages and sexes were represented with no discriminate burial selection criteria. However, there was a high proportion of Middle-aged Adults (35–45 years) in comparison to a high proportion of Young Adults, the latter being more typical of a catastrophic cemetery profile (ibid). The palaeodemographic model for St Helen-on-the-Wall generally fits the attritional mortality profile of a population originating from a poor, medieval urban parish (ie gradual mortality increase and high numbers of infants), as opposed to a catastrophic cemetery profile, in which a short-term mortality crisis is evident, with the disease epidemic targeting Young Adults and Children. Similarly, an attritional mortality profile is evident with the death assemblage at Blackgate Cemetery, London, ie a more even representation of age categories (Gowland & Chamberlain 2005: 152).

Only 14 cranial metric measurements could be taken from the entire human remains assemblage (Table 1). This data is likely to be statistically unviable for any significant osteoarchaeological analyses or interpretations. Post-cranial metrics to calculate stature did provide useful information on the biological profile of the cemetery demographic. Measurements were only taken of complete adult limb bones. When pooled, Female and possibly Female Adult individuals had a height range of 147.96–163.01cm, giving an average height of 155.48cm (5 foot 1). In-situ limb bone measurements were taken from Female Adult Sk551 but were deemed unsuitable for use due to their incompleteness. Male and possibly Male Adult individuals had a height range of 161.79–183.57cm, giving an average height of 172.68cm (5 foot 7 inches).

A recent study conducted on cemetery sites in London focused on developmental stress markers,

stature and sex of populations before the 1348 Black Death (Early Pre-Black Death 1000–1200 AD and Late Pre-Black Death 1200–1250 AD) and Post-Black Death (1350–1540 AD) (DeWitte 2018). It revealed that stature in male individuals decreased before the Black Death and increased afterwards; stature in female individuals decreased after the Black Death (*ibid*). The study concluded that a number of factors (including the disease epidemic) may influence these trends, including differences between how males and females respond to stressors, effects of nutrition (or lack of it) during puberty and a disproportionate dietary access to males in the aftermath of the Black Death (*ibid*). It was likely to have been a similar scenario with the population in Leith during the 17th century; multiple factors (including the disease outbreak) will have contributed towards stunted heights in individuals, including lack of food and the prevalence of other diseases.

Several pathological conditions were recorded on both adult and non-adult skeletons, including instances of metabolic disease, trauma, joint diseases and infectious diseases. Porotic hyperostosis (visible on the outer table of the cranial vault) was observed in four adults Sk166, Sk284, Sk482 and Sk493. Chronic iron deficiency through diet and mineral malabsorption as well as diarrheal disease and intestinal parasites is thought to have been the cause of conditions such as porotic hyperostosis and cribra orbitalia (Walker et al 2009: 109). Recent haematological studies, however, have concluded that iron deficiency cannot sustain the huge red blood cell production that is the cause of the marrow expansion which causes these lesions; it is suggested that haemolytic and megaloblastic anaemias are instead responsible for the cause of porotic hyperostosis. Interestingly, small hydatid cyst tapeworm cases were recorded from thorax and pelvic samples from three other individuals Sk382, Sk422 and Sk512. Although the tapeworm cases were from different individuals, parasitic infection may be one possible contributing factor towards porotic hyperostosis in this cemetery population.

Evidence of scurvy in the form of abnormal bone porosity and reactive woven bone formation was observed in the axial and appendicular skeletons of two individuals, Young Child Sk520 and Young Adult Sk438. This disease is brought about by Vitamin C deficiency, a mineral essential for the

absorption of iron, for immunological defence and for the maintenance and formation of body tissues such as collagen, an important protein component in connective tissues such as cartilage and bone (Roberts & Manchester 2010: 235). A deficiency of Vitamin C causes bleeding into the skin and through to the periosteum (Geber & Murphy 2012: 512–24). The manifestations of scurvy on the skeleton are the consequence of vascular responses to bleeding, or haemorrhaging of the periosteum and connective tissues; symptoms would have included bleeding, swollen gums and gingivitis, weakness and acute muscle pain, swelling of the lower extremities, vertigo, faintness and hyperkeratosis (*ibid*). Scorbutic changes in the form of porotic lesions were observed in the orbits and cranium (left sphenoid wing) of Child Sk520; porous bone formation of the posterior surface of the maxilla and severe periodontal disease were recorded in Young Adult Sk438, both of which are recognised clinical traits of the disease (Weize Prinzo 1999).

A possible instance of gouty arthritis was observed in tarsal bones of Old Adult Male Sk365. The disease is characterised by a high level of blood uric acid caused by an excess of uric acid production; urate crystals appear in the synovial fluids of joints and lead to inflammation and erosion of cartilage and bone (Ortner 2003: 583; Swinson et al 2010: 135). The joints affected are mainly the feet, hands, wrists, elbows and knees, causing immobility in the weight-bearing limbs. Gouty arthritis targets the larger tarsal joints and osseous manifestations of the condition include overhanging, erosive bony lesions. The condition also tends to affect joints asymmetrically. Overhanging erosive lesions were observed in the proximal left metatarsals Nos 1–3 and proximal and distal right metatarsals Nos 1–4 of Old Adult Male Sk365. An extremely painful condition, the joints would have been red and swollen; in modern society, multiple factors are associated with its onset, including excessive alcohol intake, a fatty and/or protein-rich diet, diabetes and heart disease (Roberts & Manchester 2010: 162). It is worth noting that the only instance of trauma that was observed was a healed fracture to the right clavicle of the same individual, Sk365, possibly caused by a crushing injury or a fall.

Several instances of periosteal new bone formation were recorded; porous woven bone was recorded on

the endocranium (left parietal) of Sk127 and lamellar striated new bone was observed on the proximal humeral shaft of individual Sk442. Individual Sk511 (Young Adult Female) had periosteal new bone formation on the right tibia. The new bone formation appeared to be porous woven bone, perhaps indicative of a leg ulcer. Periosteal new bone formation can be caused by infections and/or non-specific inflammation caused by ulcers or injuries; the condition manifests as fine pitting, longitudinal striations and eventually new growth in the form of plaque formations (Resnick & Niwayama 1995: 4435).

Evidence of tuberculosis in the form of destructive lesions on thoracic vertebrae and on the scapular glenoid fossa were observed in two individuals, Female Adult Sk422 and Young Male Adult Sk480. Tuberculosis is a bacterial infection (*Mycobacterium tuberculosis*) which primarily affects the lungs, although it also affects the glands, nervous system and bones. The bacteria target particular bones, including vertebrae, the sacrum and pelvis. A severe case of spinal tuberculosis can result in the collapse (kyphosis) of the spine caused by the destruction of the vertebral bodies (Roberts & Manchester 2010: 189).

Osteoarthritis of the articular facets and vertebral osteophytosis were observed in Male Adults Sk365 and Sk389. There would have been a higher prevalence of osteoarthritis but this analysis was hindered by the poor preservation of the bone. The vertebrae affected by degenerative joint disease in Sk365 included all lumbar and thoracic vertebrae (Grades 2 and 3) (Brothwell 1981: 150) with cervical vertebrae Nos 3–7 affected (Grades 1 and 2) (ibid). Vertebrae affected by osteophytic changes in Sk389 comprised all of the lumbar vertebrae (Grade 2) and thoracic vertebrae (Grade 2) with cervical vertebrae Nos 5–7 affected at Grade 0–1 (ibid).

Pronounced enthesal changes were recorded in several individuals, including Adult Sk221 and Adult Males Sk365, Sk389, Sk422 and Sk449/529. Pronounced enthesal changes were recorded on the femora, tibiae and radii; platymeria (unusual broadening of the femur) was observed in Adult Sk221, which was possibly caused by squatting or from repeated physical strain on the weight-bearing limbs during childhood and early adolescence (ibid: 88). Pronounced enthesal changes may be

occupation-related, which could be suggestive of a physically demanding lifestyle. The formation and development of enthesal changes on the bone, however, is also highly dependent on age, sex, height and body mass, and all factors must be taken into consideration with enthesal change analyses (Henderson & Cardoso 2013: 127). In this instance, it is more prevalent in male individuals; sex and a larger body mass may account for these enthesal changes.

Schmorl's Nodes were recorded in several individuals, including Adult Males Sk389, Sk442 and Adult Female Sk478. Schmorl's Nodes are associated with the degeneration of the intervertebral discs; the disc contents exert pressure onto the vertebral bodies, causing small, regular, oval lesions/herniations in the superior and inferior vertebral bodies (Roberts & Manchester 2010: 140). According to Waldron (Waldron 2009: 45), Schmorl's Nodes are more common in individuals who participate in heavy, physical/manual work, imposing greater stress on the lower spine. Adult Male Sk389 had a high prevalence of Schmorl's Nodes, totalling five cervical vertebral nodes (two on the superior surface and three on the inferior surface), 15 thoracic nodes (eight on the superior surface and seven on the inferior surface) and nine lumbar nodes (including four on the superior surface and five on the inferior surface). Adult Male Sk389 also had a soft-tissue injury. A high quantity of Schmorl's Nodes on an adult of this age (27–35 years) living in a poor urban district such as South Leith in the 17th century is not surprising and, similarly to enthesal changes, factors such as sex and body mass can have an impact on the development of Schmorl's Nodes. Several studies have shown that Schmorl's Nodes affect Male Adults more frequently than Female Adults (Plomp, Roberts & Strand Viðarsdóttir 2012: 572; Üstündağ 2009: 695).

Kidney stones (*nephrolithiasis*) were recovered from pelvic and thorax samples from Adult Sk166 and Adult Female Sk422. Waste products in the blood can form crystals that collect inside the kidneys and eventually turn into stones. They tend to form if the individual is not drinking enough fluids.

The prevalence of caries was low for this cemetery population and caries were only observed in six adults. Dental calculus was observed in under half the cemetery population (30 out of 74, c 40%) and



periodontal disease was recorded in five individuals via methods used by Tomczyk et al (2017), including the degree of root exposure and dental calculus among others (Tomczyk et al 2017: 206). Of interest is the unusually high percentage of individuals with linear enamel hypoplasia ('LEH', Table 1). Twenty-two individuals (15 adults, seven non-adults) had hypoplastic lines visible on the mandibular and maxillary dentition, located primarily on the incisors and canines. Such developmental defects in the tooth are formed in response to growth arrest in the immature individual, the predominant causes of which are believed to include periods of physiological trauma, including illness, nutritional stress (such as famine) or a possible weaning deficiency (Larsen 1997: 45).

The pathological evidence suggests that many of the plague victims buried in this part of Seafeld in the mid-17th century had lives characterised by poverty and toil. Lack of wealth may be indicated by the lack of caries as sugar was clearly not a common occurrence in the diet. Nutritional deficiencies resulted in poor health and stunted growth, and skeletal evidence indicated hard,

heavy work. This chimes with the historical evidence, which indicates that South Leith was the poorer of the two parts of Leith. If the victims buried at St Mary's (Leith) had not succumbed to plague, there was an abundance of other diseases evident to shorten the lives of individuals. Poor sanitation, squalid and cramped living conditions and the presence of vermin would all have facilitated disease in South Leith. It is important to note that the spread of plague would have been exacerbated by close living quarters in both rural and urban populations (Gummer 2009: 242). Life expectancy in the 17th century was historically short because of episodes of famine, disease and warfare and this would certainly have been the case with this cemetery population (Gittings 1999: 147).

The devastating impact of the 1645 outbreak of plague can be seen with the burial methods used at St Mary's (Leith); while some individuals appeared to have been simply thrown into a burial pit (indicating a lack of care), others were afforded a more decent burial with their interment in simple wooden coffins.